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And the Humans Who Love Them

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**MiGs v.
Hornets**

**Kelly Johnson:
Behind the Legend**

MARCH 2010

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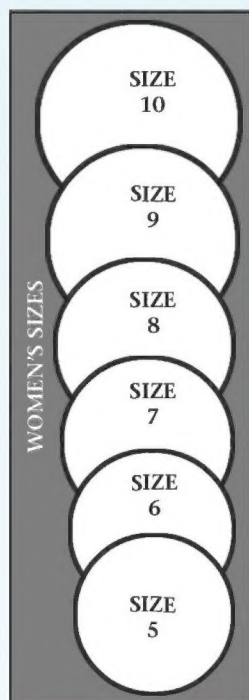
When I strolled into the palatial lobby of the Grand Casino in Monte-Carlo, I headed straight for the roulette table to place my one bet for the evening. Of course, I bet it all on black. Black diamonds that is. I met our Belgian diamond dealer in the casino here and he pulled out a black suede pouch. He had almost 900 carats of rose cut black diamonds with him. When he told me the terrific price, I said that I'll take them all. Faceted one carat diamonds for under \$200 a carat—maybe this is one time you can leave a casino with a winning hand.

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ON THE COVER: Photographer Eric Curry dramatizes the bond between Mars rovers and engineers at NASA's Jet Propulsion Laboratory (among them, from left: Nimisha Mittal, Pauline Hwang, Sharon Laubach, and Alfonso Herrera). Moves by rovers on Mars are first rehearsed at JPL.



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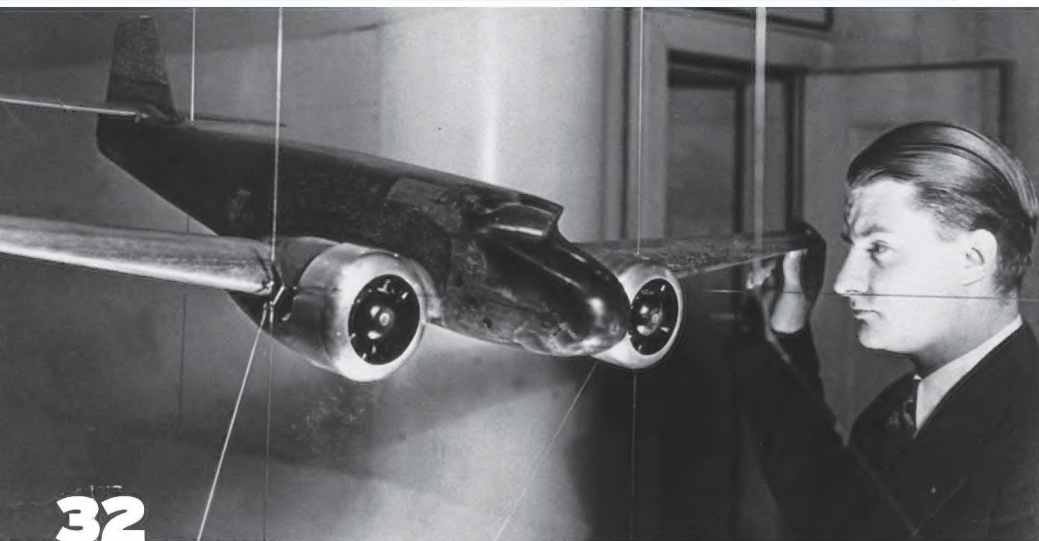
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On the Web Site www.airspacemag.com

Watch the *Air & Space* cover evolve frame by frame in a slideshow narrated by photographer Eric Curry. Curry created the image by combining multiple long exposures of a full-scale Mars Exploration Rover model with engineers at NASA's Jet Propulsion Laboratory.

Imagine examining artifacts in the Smithsonian Institution and finding a never-before-seen sketch for the largest and highest denomination American coin ever proposed? That's just what happened as one

America's Lost Masterpiece

coin expert recently explored the collection at this celebrated public institution. But as this numismatist discovered, it has more to share than he could ever imagine.

To his own surprise, he had found the original design concept for a hundred dollar denomination created by George T. Morgan, arguably the greatest American coin designer. These sketches, hidden within an original sketchbook for nearly a century, represent perhaps the grandest American coin ever proposed—the \$100 Union.

George T. Morgan will always be remembered for his most famous coin—the Morgan silver dollar. Until recently, the world knew nothing of Morgan's larger sized and higher denomination \$100 Union concept design.

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Leave the World Behind

PEOPLE WHO VISIT the National Air and Space Museum often say that they want to “experience” flight or “go” into space. Our new exhibition, “Moving Beyond Earth,” responds to their wishes. Within the constraints of gravity, we transport people with a gallery that all but puts them in orbit.

How do we do that? Engaging interactives, iconic space artifacts, and the ambience of the gallery itself work together to create the look and feel of space. The focus is human spaceflight in the era of the space shuttle and International Space Station and beyond.

In the dimly lit gallery, the view from a window of the shuttle or station stretches from wall to wall, and the high-definition Earth rolls past at about the pace it would if seen from orbit. Another wall dissolves into a high-definition visualization of the station, slowly turning and giving you the sensation that you are an astronaut flying around it with a rocket backpack.

Our tech-savvy young visitors are drawn to computers and information in motion. This exhibition seeks to engage them through several content-rich interactives. *SpaceFlight Academy* gives visitors a chance to test their spaceflight knowledge in a competitive quiz game, as if they are astronauts in training for a mission. In *Space for You?* visitors match their own interests with some of the jobs that make spaceflight happen. Another interactive, *Flight Director*, puts visitors on duty in Mission Control, working with a team of flight controllers to solve a problem in orbit. The problem, an errant satellite, is drawn from an actual

shuttle mission. The decision-making required by this game mimics the problem-solving that is necessary in spaceflight.

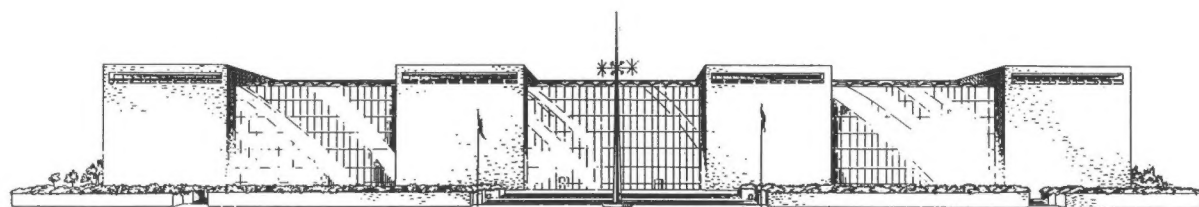
An eerie blue platform that seems to float in midair is actually our newest technology—a horizontal LCD screen, home of the space station *Design It!* activity. Here, visitors working around the touchable screen balance cost and desired capabilities to equip new modules for the station. This activity reflects the kinds of decisions that NASA makes all the time.

Among the iconic space artifacts in the gallery is COSTAR, the “contact lenses” that corrected the vision of the Hubble Space Telescope and that just returned from space last year. More flown-in-space items will shortly become available as the shuttle era comes to an end.

Unique to the Museum, a presentation stage—with cameras, lighting, and electronics for direct broadcasts, Webcasts, and live talks and demonstrations—will enable the Museum and NASA, the sponsor of this exhibition, to bring spaceflight to people far beyond Washington, D.C.

The gallery today is just the first stage of what will be, by 2011, a more complete experience of human spaceflight, as we continue to add artifacts and historical interpretation. On your next visit to the National Air and Space Museum, be sure to have your own spaceflight experience in “Moving Beyond Earth.”

■ ■ ■ J.R. DAILEY IS THE DIRECTOR OF THE NATIONAL AIR AND SPACE MUSEUM.





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How Has Christianity Changed over 2,000 Years?

In the first centuries after Christ, there was no “official” New Testament. Instead, early Christians read and fervently followed a wide variety of scriptures—many more than we have today.

Relying on these writings, Christians held beliefs that today would be considered bizarre. Some believed that there were 2, 12, or as many as 30 gods. Some thought that a malicious deity, rather than the true God, created the world. Some maintained that Christ’s death and resurrection had nothing to do with salvation while others insisted that Christ never really died at all.

What did these “other” scriptures say? Do they exist today? How could such outlandish ideas ever be considered Christian? If such beliefs were once common, why do they no longer exist? These are just a few of the many provocative questions that arise from **Lost Christianities: Christian Scriptures and the Battles over Authentication**, an insightful 24-lecture course taught by Professor Bart D. Ehrman, the Chair of the Department of Religious Studies at the University of North Carolina at Chapel Hill and the author and editor of 17 books, including *The New York Times* best-seller *Misquoting Jesus*.

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Letters

WRITE TO US

More Tales of the Dead

"Deadstick Landings" (Dec. 2009/Jan. 2010) could have included the remarkable landing of the "Gimli Glider." On July 23, 1983, an Air Canada Boeing 767 en route from Ottawa to Edmonton flamed out both engines because its fuel had mistakenly been loaded in pounds rather than kilograms. The crew glided some 60 miles to land at the former Royal Canadian Air Force base at Gimli, Manitoba. Only two of the 69 persons on board had injuries, which were minor. The *New York Times* reported this as the "first successful emergency 'dead stick' landing of a commercial jetliner." It may have helped that the captain was a glider pilot.

Two points in "Ode on a Canadian Warbird" (same issue) bear correction. Canadian World War II ace George Beurling (note correct spelling) died in Rome, not Cairo. Beurling was flight-testing a Noorduyt Norseman when the engine quit. Beurling crashed while attempting a deadstick landing.

James R. Sullivan
Los Angeles, California

A historic deadstick landing is recounted in Paul Gillcrust's book *Feet Wet*. The Navy's F-8E Crusaders had a fuel transfer problem. During a flight off the aircraft carrier *Shangri-La*, Gillcrust's wingman Stu Harrison was unable to get fuel to transfer to the tank that fed the engine. They headed back, and at

two-thirds of a mile behind the ship, Harrison's engine flamed out. With only a second or two to choose between ejection and continuing the approach, Harrison stuck with the airplane, catching the first arresting cable for the first dead-engine jet landing on a carrier.

Doug Loeffler
Boca Raton, Florida

Déjà-Tu

Reading "The Do-Everything Bomber" (Dec. 2009/Jan. 2010), I had the feeling that I had seen the Douglas 1211-J before, in the form of the Tupolev Tu-95 Bear. There are not many large, slim, swept-wing, four-engine, turboprop bombers with counter-rotating propellers.

Tom Barnes
Carlsbad, California

The authors, John Aldaz and Sir George Cox, reply: The Douglas 1211 was designed a few years after Tupolev carbon-copied most of the B-29 into its Tu-4 bomber. It is very possible the Tu-95 received like-minded "technology transfers" from the Douglas 1211 studies. Donald Douglas Sr. pointed to the 1211's distinctive wing structure, designed to distribute weight span-wise while reducing critical bending loads at the root, which can also be found on the Tu-95. However, direct evidence showing the Tu-95 was another product of industrial

espionage has yet to surface. In addition, Russian aerospace scholars rightfully argue the Tupolev design bureau was also capable of brilliant, independent thinking, and that similar requirements can lead to identical solutions.

Little but Tough

"Super Tweet" (Dec. 2009/Jan. 2010) will help more people appreciate the role the A-37 Dragonfly played

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Self-portrait of U-2 pilot Andrew McVicker, who says he enjoyed the photo tips in "Hit Me With Your Best Shot."

Brazil Expedition Uncovers Thousands of Carats of Exquisite Natural Emeralds

Brandish a whopping 50 carats of genuine South American emeralds in a handcrafted new necklace design for less than \$200... and get a \$100 Stauer Gift Coupon!

Halfway into our ambitious trek through the rain forest I had to remind myself that "Nothing good comes easy." These days it seems that every business trip to Brazil includes a sweltering hike through overgrown jungles, around cascading waterfalls and down steep rock cliffs. But our gem broker insisted it was worth the trouble. To tell you the truth, for the dazzling emeralds he delivered, I'd gladly go back to stomping through jaguar country.

Now our good fortune is your great reward. Don't miss this rare opportunity to own an impressive 50 carat strand of genuine South American emeralds for under \$200. And for a limited time, we'll sweeten every necklace order with a **\$100 Stauer Gift Coupon!**

Faced with this embarrassment of riches, our designer transformed this spectacular cache of large stones (each is over 8 carats average weight) into a stunning 50 ctw necklace of faceted emeralds set into .925 sterling silver. Each emerald is surrounded by delicate sterling silver rope work and filigree in the Bali-style. The 18" necklace dangles from a sterling silver chain that fastens with a secure double-sided shepherd's hook clasp.

What is the source of our emerald's timeless appeal?

The enchanting color of the Stauer *Carnaval* Faceted Emerald Necklace comes from nature's chemistry. Our polished and faceted, well-formed natural emeralds are immediately recognized as something special. Indeed, when we evaluated these emeralds, color was the most important quality factor. Today, scientists tell us that the human eye is more sensitive to the color green than to any other. Perhaps that is why green is so soothing to the eye, and why the color green complements every other color in your wardrobe.

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Letters

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Anyone who flew, worked on, or just admires the little fighter can get more information on it at www.A-37.org.

Ollie Maier
San Marcos, Texas

Editors' reply: The official U.S. Air Force mission tally, 68,471, does not include missions flown by the South Vietnamese air force, which also flew the A-37.

Thank You, Mrs. Goddard

In the early 1950s, when my brother and I would walk to and from Gates Lane Elementary School in Worcester, Massachusetts, we passed the house where Robert Goddard had lived (Viewport, Sept. 2009). We often spoke with Mrs. Goddard when she was in her yard. At times she invited us into the house and showed us the things that were in her late husband's study and workshop. Sometimes we would skip our Saturday catechism class and spend the morning in Dr. Goddard's study and workshop, touching the many strange things and wondering: What were they part of? What were they used for? It wasn't until many years later that I learned that we lived a few hundred yards from where he had launched some of his rockets.

As an adult, I have contributed to several space-related projects in the aerospace field. It was Mrs. Goddard's generosity that piqued my lifelong interest in rocketry and aviation.

Richard DesChenes
Camp John Wise Aerostation
Archer, Florida

The Start of Something Big

"The Big Race of 1910" (Dec. 2009/Jan. 2010) did not mention another reason that the Dominguez Hills site was chosen for the first U.S. air race: The underpowered airplanes would get an uplift from the conjunction of the ocean breezes and the hill.

It is also interesting to note that the event led to the establishment of southern California as the main U.S. site for the infant aircraft industry. After the air meet, local airplane builder Glenn Martin went on to launch his career near Los Angeles. By the time Martin departed for other locations, he had hired and worked with other notable aviation pioneers, including Lawrence Bell, Donald Douglas, and John Northrop. Several decades prior to World War II, these leaders joined Howard Hughes, the Loughhead (Lockheed) brothers, Gerald Vultee, T. Claude Ryan, and others in creating the nation's largest aviation center.

William F. King
Mt. San Antonio College
Walnut, California

Corrections

Dec. 2009/Jan. 2010 "Deadstick Landings": Andrew King's Pitcairn Autogiro experienced engine failure over New Carlisle, not New Castle, Ohio.

Reviews & Previews: We regret omitting the credits for the three photographs of Amelia Earhart on p. 78. The top and bottom images are from Purdue University Libraries, Kames Archives and Special Collections Center. The middle photograph is from the Schlesinger Library, Radcliffe Institute, Harvard University.

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Sightings

PICTURES WORTH A SECOND LOOK

IT BLEW IN LIKE A LION, the manned commercial space age, on Monday, December 7, 2009. That evening, 800 invited guests—two governors, future astronauts, VIPs, and media—gathered at the Mojave Airport in California for the unveiling of Virgin Galactic's *SpaceShipTwo*, now named Virgin Spaceship (VSS) *Enterprise*. The one uninvited guest was a freak storm that crashed the party with freezing temperatures, rain, snow, and hurricane-force winds that would have flung the rocket and its mothership, *WhiteKnightTwo*, across the desert had they not been spirited to shelter in advance of the serious gusts.

Before all that happened, photographer Chad Slattery ambled up to the vehicles as the company's marketing team was shutting off the lights. He snapped a photo (right) of the starboard hull of the mothership lit by the blue theatrical lights that were the last to go out. Slattery's view captures a string of stylized silhouettes called the "DNA of Flight" that, according to Virgin Galactic, shows, from left: the mythic Icarus, the Wright Flyer, the *Spirit of St. Louis*, the Bell X-1, the Boeing 747, the Apollo lunar lander, and *SpaceShipOne*, the first civilian-made, -funded, and -flown manned rocket to reach space.

A few minutes earlier, Slattery had snapped a rear shot (below). The white lights were still up, along with the stanchions holding a security rope, which the wind shortly blew down. "Both pictures are unmanipulated," says Slattery. "It was surreal, with wind kicking up moisture from the rain-slicked ramp and turning it into vapor. And with the music playing, it was like a scene out of *Close Encounters of the Third Kind*." He used a 24-mm tilt-shift lens intended for indoor architectural work. "I just planted the tripod, shifted my lens, and banged off the shots," he says.





The Last Time We Saw Paris...

AT A PRESS conference held last October at the National Business Aviation Association convention in Orlando, Florida, a group calling itself the MS760 Corporation announced its intention to enter the very light jet market with an airplane that first flew in 1954: The Morane-Saulnier MS.760 Paris. Some veteran aviation writers at the NBAA show expressed skepticism when the group said it planned to resume production of an airplane designed more than 50 years ago.

The Paris is based on the loser of a 1950s competition for a French air force trainer. For the competition, Morane-Saulnier offered a two-seat side-by-side twinjet, but the French selected the more conventional tandem-seat Fouga Magister at about the same time Cessna was designing the T-37 with side-by-side seats for the U.S. Air Force. To make lemonade of their lemon, Morane-Saulnier built a four-seat utility transport version, the MS.760, which the French air force bought. Admirals and generals zipped around France in the liaison aircraft. Argentina and Brazil ordered some for their air forces as well, assembling them locally.

Beech Aircraft caught



wind of the airplane and after it was certified by the Federal Aviation Agency in 1958, toured the United States demonstrating it to businessmen. A small folding ladder stored in the glove box was used to board and disembark. Legend has it that when Beech matriarch Olive Ann Beech got one look at that ladder, she stated flatly that no self-respecting woman would climb into an airplane that way. Whether it was Mrs. Beech or the simultaneous arrival of the Learjet 23 that killed the Beech Paris deal has been forever lost.

The Paris jet (shown here in Argentine air force livery) was a Very Light Jet before the term came into use.

Enter Edward Furtak and his company, JetSet International, a Bermuda-based investment firm. Furtak fell in love with the 400-mph Paris, sold his piston-engine Mooney, and in 2007 bought one of the little jets. He set up a subsidiary in France and reached an agreement to acquire the type certificate for the Paris from SOCATA, a French company that absorbed the assets of Morane-Saulnier. Furtak's subsidiary will own the type certificate after the transfer is

completed this year and will license it to the Florida-based MS760 Corporation.

Greg Webster is one of a very few U.S. Designated Pilot Examiners approved by the FAA to award type ratings in the Paris. (Despite its size, the aircraft is turbojet-powered and requires the rating.) He says he has been flying the Paris for more than 30 years. Webster sold Furtak his Paris and helped import the first 20.

The Beech tour was "to measure market

acceptance,” says Webster. “They toured with three mechanics and a pilot. They’d show up at airshows, pull up in front of the crowd, and disassemble the airplane right there. When they had it completely apart, they put it together, started it up, and flew an airshow routine. The guys who designed the airplane gave it a lot of forethought. It’s really cheap to maintain.”

The jet has a surprising following, considering its age. MS760 has a plan to modify the airplane with either one or two modern turbofans to improve runway performance and fuel efficiency while eliminating the loud dog-whistle noise of the original Turbomeca Marboré engines. And Webster says that boarding ladder is bye-bye.

GEORGE C. LARSON

Somebody Wants It

LAST OCTOBER, one of NASA’s X-38 vehicles, part of a 1990s Skunk Works-style project to develop a lifeboat for the International Space Station—and possibly a taxi to fly astronauts there—arrived at the Strategic Air & Space Museum in Ashland, Nebraska, where it was welcomed by a high school band, a mayor, and a lieutenant governor.

The X-38 project was based at NASA’s Johnson Space Center in Houston, Texas, which wanted an alternative to relying on Russian Soyuz capsules to bring home up to seven ISS crewmembers in an emergency. A small cadre of young engineers took on the work in-house in 1995.

NASA’s X-38 lifeboat sails to a smooth touchdown on the lakebed at California’s Dryden Flight Research Center in 1999.

Three years later, flight tests began. The team made well-publicized progress, conducting 48 test drops of the X-38’s 7,500 square-foot parafoil—the largest ever flown. The prototype vehicles were dropped eight

times from NASA’s venerable B-52 mothership, culminating in transonic flight on a trajectory matching the planned path of an operational vessel returning from the space station. The European Space Agency, which was a partner in the X-38 program, was looking at modifying the lifeboat into a capsule. The launch of a full-scale demonstration vehicle on the space shuttle had been scheduled when NASA, reeling from space station budget overruns, abruptly cancelled the program in 2002. “We were just hitting our stride with the drop vehicles when the program was cancelled—and cancelled with extreme prejudice,” says X-38 program manager John Muratore, who has since left NASA. “Suddenly it became very politically incorrect to even talk about it.”

The program’s cancellation left the station still dependent on Russia to supply lifeboats. With the

HEADS UP

Living History Flying Event: The Search for Gertrude Tompkins Silver

AVIATION ARCHEOLOGIST Gary Patrick Macha will talk about his search for Women Airforce Service Pilot Gertrude Silver, which

is now focused on California’s Santa Monica Bay. Silver and her North American P-51D vanished after departing Mines Field (now Los Angeles International Airport) on October 26, 1944. She remains the lone missing WASP of the 1,074 who ferried combat aircraft during World War II. The museum’s P-51D will make a demo flight.

The Planes of Fame’s P-51D makes regular demo flights. Attendees at Living History Events can enter their names in a drawing for a warbird orientation flight.

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TOP: TONY LANDIS/NASA DRYDEN; LEFT: PLANES OF FAME

shuttles due to retire this year, NASA has turned over all post-shuttle crew transport services to Russia, at \$51 million a seat.

“Our plan was to derive a version to put on [the European launcher] Ariane 5—that’s why we modified the shape,” Muratore says. “We’d have had alternative access to the station.”

Muratore says the program was a mere 18 months from flight: “It was a space vehicle ready to go. We were about \$50 million

away from getting there. That’s why we couldn’t believe it was cancelled.”

The X-38’s story may not be finished. “Sooner or later, we’re going to build another rescue vehicle,” says Muratore, who now teaches aerospace engineering at the University of Tennessee. “Especially as space evolves more toward commercial operations, there’s going to be a need for rescue.”

Clayton Anderson, Nebraska’s first astronaut,

was at Johnson Space Center for the X-38 send-off. He will make his second spaceflight this spring.

IRENE KLOTZ

Bell Bails from the Bubble

AN ICON HAS been sold. Bell Helicopter Textron has transferred the Model 47 type certificate to one of its service facilities, Scott’s

Helicopter Services in Le Sueur, Minnesota. From now on, parts and technical support for all Model 47s—H-1, 2H1, and 2H3—will not come from the factory but from the new owner. The type is now called the Scott’s-Bell 47.

The Model 47 with its bubble canopy was the primordial commercial helicopter and has been a familiar image on everything from TV’s “M*A*S*H” to the emblem for the Whirly-Girls

OFF THE AIR

Move Along, Nothing to See Here...

FAT ALBERT, the U.S. Navy Blue Angels support C-130T, made its last loud, fiery jet-assisted takeoff, or JATO, on November 14, 2009, during the team’s homecoming airshow at Naval Air Station Pensacola in Florida. A C-130 demonstrating JATO has been part of the Navy team’s act since 1975. Climbing at a 45-degree angle, a C-130 JATO reaches 1,000 feet in just 15 seconds, but it burns through eight solid-fuel rocket bottles on every



A Starfighter, no longer the star of the show (above); Fat Albert blasts off (below).



liftoff. *Fat Albert* pilot Major Drew Hess says the supply of bottle rockets is dwindling – they haven’t been used in combat since Vietnam – and the Blue Angels budget can’t cover replacements. Hess says they’re working on some sort of alternative crowd-pleasing demonstration.

And you’ll no longer hear the howl of the tailpipe exhaust from a taxiing F-104 at airshows, now that the Starfighters team, founded in 1995, has contracted with NASA to provide training and research and development for suborbital commercial spaceflight at Florida’s Kennedy Space Center. The Starfighters now have four F-104s, flying only at KSC, and plan to add another five.

Joe Chappell

FLIGHT ENGINEER, AIR FORCE ONE

International Women Helicopter Pilots. It is still one of the most numerous models in the global fleet, which is partly explained by the fact that at one point, there were more Bell 47s registered than Bell had manufactured, which pretty much proved what had long been suspected: Helicopters were being built from parts and placarded with fake manufacturer plates.

The Bell 47 carried presidents and litters, and it is still one of the dominant types in training and agricultural operations around the world. It was the first Bell machine designed by the legendary Arthur Young, who invented distinctive weighted stabilizer bars and mounted them across the mast perpendicular to the blades to smooth out forces on the rotor. The two blades pivoted like a see-saw on the mast, which gave rise to the name "teetering" to describe the main rotor. The rotor system was most appreciated by students learning to autorotate, or land following loss of power. The big blades on the -47 (and later Huey, another icon) stored a lot of energy and made the maneuver relatively easy.

Bell had little reason to continue to support a machine that dates back to 1946 and runs on gasoline. The sale is undoubtedly a sign that the company will be offloading some of its older models and getting them out of the factory.

 GORDON CARUSO

AS A CREW MEMBER on Air Force One from 1961 to 1980, Joe Chappell insured the safe operation of the aircraft for U.S. presidents John F. Kennedy, Lyndon B. Johnson, Richard M. Nixon, Gerald R. Ford, and Jimmy Carter.

A recent TV presentation discussed the secrecy surrounding George Bush's 2003 mission to visit the troops in Iraq for Thanksgiving. Have you had similar experiences?

Many. Some we have made public, some not. When Nixon was president, [National Security Advisor] Henry Kissinger met 17 times in France with the North Vietnamese, negotiating the cease-fire and peace agreement. We always needed a cover story. Kissinger was known as a ladies' man. He would be seen at a social event with a cocktail Friday evening and he was thought to be shacking up with someone over the weekend, but he would really be with the North Vietnamese. And he had twice met with the Chinese secretly, behind the Iron Curtain, negotiating a presidential visit to open relations with the Chinese. No one knew anything about that until Nixon went to China.

Which president did you connect with the most?

Johnson and I got along really well for some reason. He had many modifications he wanted done on the airplane and I would get them done.

He tried to do a good job—he worked hard, he liked to run everything, wanted to get involved in small details. That was just his nature.

Most Americans remember the Walter Cronkite broadcast the day President Kennedy was shot. Were you able to see it?

I saw the reaction of my fellow crew members. I had traveled with them for a long time, and I thought, *Gee, if these guys are showing emotion, this has got to*

be bad. I heard about the assassination after Cronkite had made the broadcast.

You were aboard Air Force One when Lyndon Johnson was sworn in?

Yes, when he came into the cockpit, he had told police not to delay Judge Hughes. I went outside and told a policeman I was

waiting for Hughes. He said, "This is the judge now." I saw a big black Buick coming up. The guy driving was wearing a Texas hat and a nice suit. I said, "Judge, will you come with me?" He said, "Just a minute." I had assumed he was the judge, but he was the driver—the judge was in the back seat. I escorted Judge Sarah Hughes as she boarded the airplane. It was a very brief ceremony. I'm sure you've seen the picture; I was standing right there.

(In that photo, often called the most famous ever taken aboard Air Force One, Chappell is behind Hughes, next to the photographer, and thus not visible.)

Interviewed by Christopher Saccoccia

Read the entire interview at www.airspacemag.com.



Joe Chappell stays in touch with current Air Force One crews.

In the Museum

STOPS ON A TOUR THROUGH AMERICA'S HANGAR

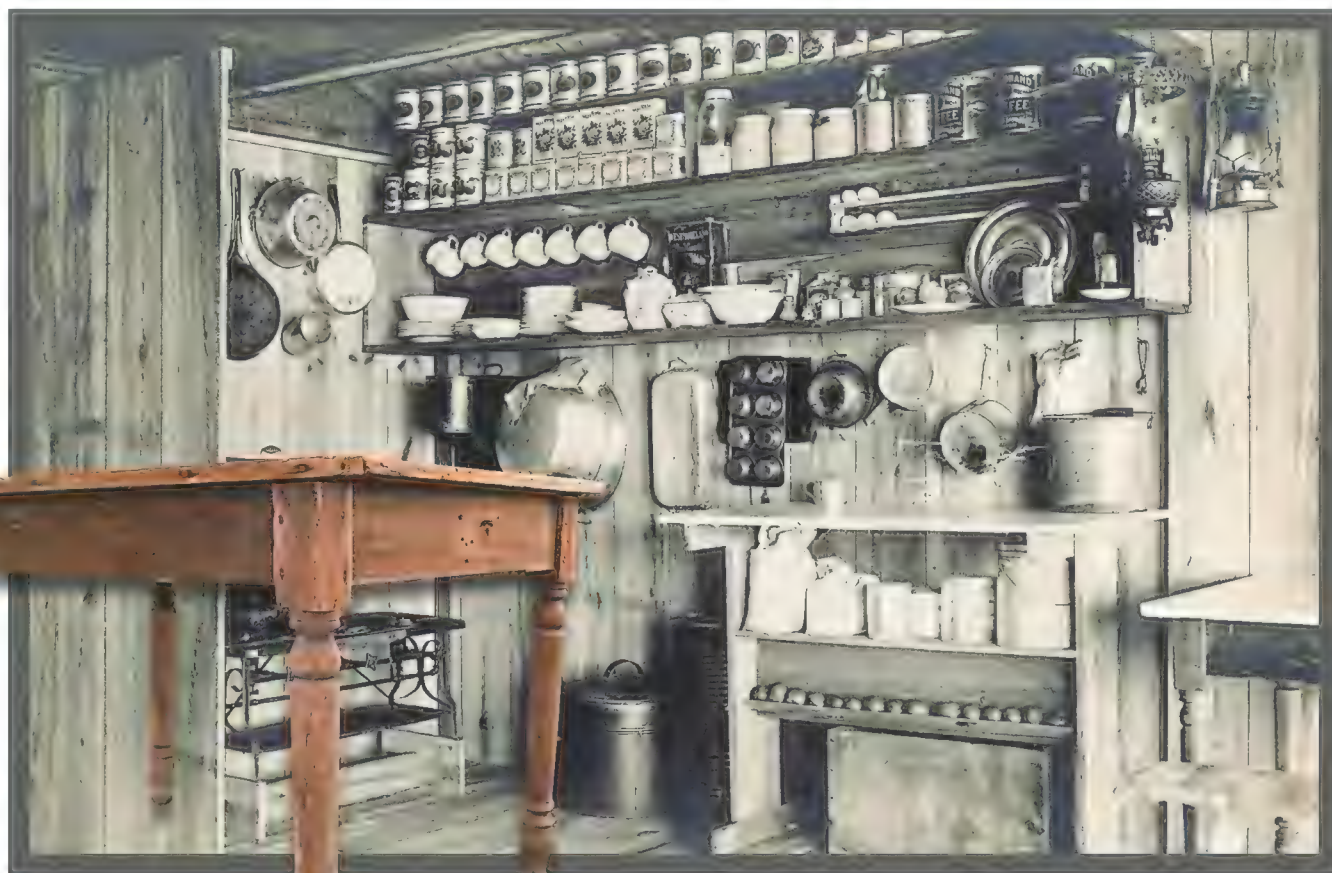
A Wright Relic Surfaces

IN LATE AUGUST 1902, Wilbur and Orville Wright traveled from Dayton, Ohio, to Kitty Hawk, North Carolina, to test and develop one of their gliders on the windy dunes of the Outer Banks. Encamped in a rustic shed, they loved to tell their sister, Katharine, about their domestic ingenuity. In a letter dated August 31, Wilbur describes the brothers' kitchen: "We also set up our table and covered the top with white oil cloth...."

More than a century later, on the evening of March 12, 2008, a young man named Ron Ciarmello called me with a remarkable story. "I think I have just found the original table from the Wright brothers' camp," he said.

As a Wright historian, I hear claims like this fairly frequently, and I was skeptical. Between the ravages of Outer Banks weather and coastal people's practice of "salvaging" unattended property, it was unlikely the table had survived. And even if it had, how could you prove such a claim? Ciarmello had bought the table from a local family who said they had owned it since the days the Wrights had walked on the Outer Banks. But historians need more evidence.

Ciarmello had already done some homework. On the Library of Congress' Web site, he had found a photograph of the shed's kitchen that showed a corner of a table. "I swear it's the same table in that picture," he said. And he had found a second photograph of the table in a book I had written on hidden images in



Is the table at left the same one the Wrights built for their neat-as-a-pin Kitty Hawk kitchen in 1902 (above, at right)? To find out, a team of students, historians, and laypeople scoured the evidence.

the Wright brothers' photographs.

I asked Ron to e-mail photographs of his table, and when they arrived, my eyes popped. *It's possible*, I thought. And if it was the real thing, it was a major find: The Wrights' diaries and letters recount that the brothers did their writing and sketching on it. In a way, the table was the center of the camp.

A few weeks later, I went to Kitty Hawk to meet Ron and examine the table. It was smallish—the top was 39 5/8 by 30 inches. The base had once been part of a small writing table. There was an opening that once held a drawer. The legs were crudely formed on a lathe, each one a little different.

Most of the top's pine boards were attached to one another with tongue-and-groove joints, and I concluded that they had once been part of a crate—the

kind the Wrights used to ship equipment, tools, and flying-machine parts from Dayton. Someone had written on the underside of the top "W. Wright, Elizabeth City, NC." This was probably the shipping address the Wrights had inscribed on the crate. And the writing looked like handwriting on other items the Wrights owned.

One piece of evidence convinced me that this was indeed the table from the Wrights' camp. Two strips of wood were used to widen the top, and they were different from the crate planks: Unlike pine, they had a fine linear grain, typical of high-quality wood, likely spruce. I believe they were from a stash of wood that the brothers reserved for repairing their ash-and-spruce aircraft. Though the Wrights were eager to build the 1902 glider—the one on which they first

achieved controlled flight—they appear to have used a little precious flying-machine material to finish the table.

I enlisted the help of photo-analysts at the school where I teach, East Carolina University, and we matched the table's wood grain, leg turnings, and nail holes with those visible in the photograph in my book. We later took the photograph and the table to my documentary editing class, and the students identified tiny holes that could have been left by tacks holding down the oil cloth covering.

When we looked at this nondescript piece of furniture, we could then envision the late-night scribbling, pounding of fists, and *Eureka!* moments. The table became infused with the aura of mystery that surrounds places where humans made history.

After more studies, we shared our findings with the National Air and Space Museum. Finding our conclusions compelling, the curators



Donald D. Engen Tower The Udvar-Hazy Center has an observation tower from which visitors can watch air traffic arriving at and departing from Washington Dulles International Airport. The only way to access the tower is via an elevator that rises 164 feet above the ground. The elevator can transport 15 people every five minutes.



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examined the table and, convinced of its authenticity, agreed to exhibit it in the gallery "The Wright Brothers and the Invention of the Aerial Age," beginning last January. Now visitors will see two items crafted by the Wrights: the world's first airplane, and

a kitchen table. Says senior aeronautics curator Tom Crouch, a Wright brothers authority, "This beat-up, slapped-together piece of furniture will help to bring the story of the invention of the airplane to life for Museum visitors."

LARRY E. TISE

A Gift of Art

THE WORKS OF ART on display at the Museum's Steven F. Udvar-Hazy Center are part of a group of 42 aviation prints by renowned artist Robert Taylor, each one signed by the airmen whose exploits are depicted. Michael and Maureen Harrigan of Kendall, New York, donated the collection.

In 1988, Mike's firm, the Harrigan Brady Paper Company, had a lot of wall space to fill. Mike learned of the work of the English master of aviation art, Robert Taylor; Harrigan's first acquisition, a print titled *Home at Dusk*, showed a flight of four P-51 Mustangs crossing the East Anglian coast on their way back to base. The print was signed by six Mustang aces. Mike was hooked, and the number of Taylor prints on his wall grew.

Over the years the pictures drew some interested queries from aviation museums, including both the Pima Air & Space Museum in Tucson, Arizona, and the National World War II Museum in New Orleans, Louisiana. Someone once asked Mike if he would ever part with the collection. His answer: "Well, if the Smithsonian walked in, I'd have to consider it." To make a long story short, we did, and he did. Many visitors wonder where the Museum gets the items that it displays. The answer is, very often from generous people like Mike Harrigan with a passion for flight, and a determination to share it with the public.

TOM CROUCH, SENIOR AERONAUTICS CURATOR



The Harrigans' extensive aviation print collection (here, *Zero Encounter*) renders the history of World War II from Europe to the Pacific.



Visit our Web site to see more prints from the collection.

The Unhappy Bottom Riding Club

THOSE OF US IN FLIGHT TEST at California's Edwards Air Force Base in 1959 accused the Lockheed F-104 Starfighter production engineers of turning the designer's drawings upside down. The wings of most aircraft employed dihedral—they were set at a slightly upward angle—but the F-104's wings angled in the opposite direction; the horizontal stabilizer and elevator sat atop the vertical stabilizer instead of below it; and the ejection seat fired down instead of up. We could recover from the spin that resulted from the aircraft pitching up uncontrollably when it stalled, which was due to the T-tail configuration, but most pilots who used the Stanley C-1 downward seat ejection system didn't live to complain about it. Twenty-one had died in downward ejection seat accidents, including, in 1958, X-2 and X-15 test pilot Ivan Kincheloe.

The seat required the pilot to wear metal "spurs" on the heels of his flight boots, thus earning an F-104 pilot the nickname "Cowboy." The spurs had slotted receptacles that the pilot slipped over steel balls at the base of the seat's foot rest. The balls were

The author just discovered a Pancho's Happy Bottom Riding Club T-shirt he had stored away from his stint at Edwards Air Force Base – never worn.

of these design decisions in late June 1959. I had just returned to the Mojave Desert from a couple of weeks leave on the East Coast and stopped by Test Operations to check on the status of the Republic F-105 that I was flying in a stability and control test program. My boss, Lieutenant Colonel C. E. "Bud" Anderson, asked if I would stand by for a safety chase flight he was scheduled



At 35,000 feet, 65 miles west of Edwards, Woodman and I had reached 1.87 Mach when my engine developed excessive vibration. A glance at the instrument panel showed I was losing oil pressure – a recurring problem with the early J-79s. I immediately reduced power and turned back toward the base. I thought: *This really can't be happening to me!*

anchored to cables on the seat that automatically pulled the pilot's boots against the base of the seat so that when he ejected, he could safely clear the aircraft in one piece.

I conducted my own investigation

to fly—it had been delayed all day and probably wouldn't go. It was already 5:30 p.m., and the colonel had to meet visiting Royal Air Force test pilots at the golf club. As soon as he left, Flight Lieutenant Jack Woodman called: The

flight was on. He was evaluating a Grumman F11F-1F as a fighter for the Royal Canadian Air Force.

In an attempt to give the F11F enough power to reach Mach 2, engineers had installed a General Electric J-79 engine—the same engine used in the F-104. I was flying safety chase in an F-104A, even though the aircraft were still in test status. The -104s were the only aircraft we had that would reach twice the speed of sound.

At 35,000 feet, 65 miles west of Edwards, Woodman and I had reached 1.87 Mach when my engine developed excessive vibration. A glance at the instrument panel showed I was losing oil pressure—a recurring problem with the early J-79s.

I immediately reduced power and

turned back toward the base. I thought: *This really can't be happening to me!* Knowing the procedure for placing the minimum balanced load on the engine compressor bearings, I had throttled back to 88 percent power. I was 15 miles from Edwards and at 15,000 feet and 450 mph when the pressure reached zero. I was too high to touch down safely on the 15,000-foot main runway, but the dry lakebed provided miles of overrun. Changing the throttle position would surely cause trouble, so I tapped the speed brake switch. Big mistake. The aircraft shuddered, the fire warning light came on, the engine ground to a stop, and the cockpit filled with smoke. In just a few seconds, I was able to see my altimeter as it unwound through 7,500 feet—ground elevation was 3,000 feet—and my airspeed drop to 275 mph.

I had to eject. Immediately.

I reached down and pulled the D-ring on the front of the seat, which would fire the ejection cartridge. Nothing happened. I pulled again—still nothing. Looking down to make certain I had gripped it properly, I pulled again with all my might. I felt a tremendous blast of wind as I was fired toward the ground.

I had been told that if you had time to think about the parachute deploying, that meant the lanyard that connected the seat to the parachute D-ring hadn't worked. I looked at my lap to see if my seat belt had opened—it had. At the same time, I reached for my parachute D-ring and found it still in place on my chest strap. To manually activate deployment, I grabbed the D-ring and threw it far from my chest. The pilot chute streamed between the seat and my body, pulling the parachute out. The

parachute canopy began to unfurl from my left side. Next came a tremendous shock on my shoulders as the chute deployed, snapping me around like a rag doll. Now I was plummeting head-first toward the desert. The next shock was in my groin as the chute fully deployed. The canopy was above my head—the most beautiful sight I've ever seen—even if

Changing the throttle position would surely cause trouble, so I tapped the speed brake switch. Big mistake. The aircraft shuddered, the fire warning light came on, the engine ground to a stop, and the cockpit filled with smoke. In just a few seconds, I was able to see my altimeter as it unwound through 7,500 feet – ground elevation was 3,000 feet – and my airspeed drop to 275 mph.

the horizon was running directly through the middle of it, indicating that I was horizontal to the ground, which was fast approaching.

Using all my remaining strength, I pulled the parachute's top shroud lines and stopped my pendulum swing almost directly under the canopy. The ground was racing toward me, and before I could get turned around to face downwind, I hit the ground rotating. I landed in what had been Pancho Barnes' Happy Bottom Riding Club dump and was dragged for 40 yards on my back through broken glass and tin cans until my chute got hung up on a yucca tree.

The aircraft went in five miles short of the runway at Edwards. I was one happy aviator, even though my flightsuit was torn and covered with blood and sand, I had cracked several vertebrae in my lower back, an air police pickup truck almost ran over me, and a doctor on his first day at the

base hospital and a pediatrician on his first rescue helicopter ride dropped me from the stretcher a couple of times.

Mine was the last downward ejection from an F-104. The aircraft got a Lockheed C-2 upward ejection seat, an oil pressure warning light, and a "butt kicker" system that throws an ejecting pilot out of the seat after the C-2 clears the aircraft.

The investigation revealed the oil pressure loss was caused by a rupture in an expandable oil line. The loss of cooling oil melted the compressor bearings, which caused the compressor blades, rotating at 18,000 rpm, to shift, impacting the fixed stator blades and destroying the engine.

A later examination showed that the cable, which was attached to the firing initiator, was wound in three loops and encased under a plate that was bolted to the seat front. The last time the seat was inspected, the last loop had gotten wedged between the seat and the plate when the cover plate was bolted to the seat. The investigators estimated that to stretch the inside strands of that trapped loop one-sixteenth of an inch, just enough to fire the seat ejection cartridge, I had to have pulled hard enough to create a force of 450 pounds.

Someone up there must like me.

 NORVIN C. EVANS

Oldies & Oddities

FROM THE ATTIC TO THE ARCHIVES

Tinseltown's Training Base

DURING WORLD WAR II, a complex in Arizona served as one of the world's busiest centers for training military pilots. With four privately owned airfields in and around Phoenix, the Thunderbird facility, named for the Native American mythological spirit, ran roughly 20,000 pilots from some 30 Allied nations through primary training, an achievement made possible by a confluence of military necessity, business opportunity, and Hollywood star power.

Even as late as 1940, the United States military was woefully unprepared for the coming war. The Army Air Corps had only two training fields, both in San Antonio, Texas, and General Hap Arnold begged civilian operators to provide primary instruction for military aviators. His plea was music to the ears of Leland Hayward and John H. (Jack) Connelly. Hayward was an A-list Broadway and Hollywood agent who later produced movies and shows such as *Mister Roberts*, *The Sound of Music*, and *The Spirit of St. Louis*. Connelly was a former Army aviator and Civil Aeronautics Administration inspector.

In 1940, they bought a training operation at Sky Harbor Airport in Phoenix and hatched plans to build a bigger field in nearby Glendale. They enlisted John Swope, a commercial pilot and photographer who had once shared a bachelor pad with Jimmy Stewart and Henry Fonda and who would later collaborate with John Steinbeck on the book *Bombs Away*. To oversee the venture, Connelly, Hayward, and Swope founded Southwest Airways (no connection to Southwest Airlines).

Stewart and Fonda invested, along with Robert Taylor, Cary Grant,



Students, wearing parachutes, preflight an endless lineup of Stearmans.

Hoagy Carmichael (who occasionally played the piano in the canteen), and Janet Gaynor. In 1942, director William Wellman (*Wings*, 1927) used the field to film the wartime drama *Thunder Birds*.

Ground was broken on January 2, 1941, and less than three months later Thunderbird Field opened with 14 flight instructors and 53 cadets—42 of whom would graduate—flying brand-new two-place Stearman biplanes leased from the Army. By 1942, Hayward and Connelly had opened a second Thunderbird field, managed by Swope, and Falcon Field, which was commissioned by Britain's Royal Air Force. The Brits appreciated Arizona's hospitable weather, which offered 673 consecutive flying days. Later, while piloting Spitfires over Western Europe, Royal Air Force Sergeant Philip Park wrote to his former instructor: "I'd give anything to be back in Phoenix and the sunshine."

Thunderbird achieved international prominence—and made the cover of *Life*—as the only U.S. facility to train

Chinese pilots. Numerous languages and accents were heard at the fields. But most cadets who went through the nine-week program were Americans, many of whom earned their wings only months after their first flight.

"The area was pretty desolate," recalls Donald W. Marsey, Class 43-J graduate, who flew 35 missions in a B-17, *Wisconsin Beauty*. "But what I remember most is the exhilaration of learning that I could fly an airplane."

Even before the war's 1945 end, all four training facilities were closed. Thunderbird Field is today the site of the Thunderbird School of Global Management, which has nothing to do with aviation. Two of the original hangars still stand, along with two brick barracks and the administration building. The tower is being restored, with a pub on the ground floor. Visitors should soon be able to imagine the rumble of Continental R-670 radials and Hoagy Carmichael tinkling "Stardust" on the piano.

PRESTON LERNER

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NEARLY THREE MILES above the turquoise waters of the South China Sea last July, U.S. Marine Lieutenant Colonel Dan Shipley eyed the dim outline of a fast-approaching Mikoyan-Gurevich MiG-29 Fulcrum. Flying with the Royal Malaysian Air Force on a training mission, Shipley had been tracking the MiG by radar from the cockpit of his Boeing F/A-18D Hornet. While Shipley and Captain Justin Archibald, the Hor-

net's weapons and sensors officer, could have tried to simulate firing an air-to-air missile at the MiG from a distance, the war game required that the two confirm with their eyes that the MiG really was a MiG, and not a friendly military aircraft or an unarmed civilian airplane.

The Hornet and MiG rocketed past each other at a combined velocity of nearly 1,000 mph, granting each side a clear, albeit fleeting, view of the opposing jet. Both fighter pilots banked hard, each trying to maneuver into position first and stay there long enough to make the other one fall victim to an air-to-air missile

or a volley of cannon rounds.

The MiG went nose-high, its pilot relying on the Fulcrum's superior thrust-to-weight ratio to vertically outrun the Hornet. Anticipating this, Shipley had pulled the Hornet's nose up and torqued the jet inside the trajectory of the MiG, a maneuver generating 6.8 Gs. Fifteen seconds and two high-G turns later, with the tail of the MiG directly ahead and the distinctive squeal in his headset telling him the infrared seeker in one of the Hornet's missiles had a lock, Shipley squeezed a red trigger on his control stick, sending a signal to fire. Forty-five seconds into the

engagement, the Hornet's mission computer confirmed a simulated kill.

Later that day, Shipley and Archibald met up with the MiG pilot, Major Ahmad Khusairi bin Ahmad Fadli, in an air-conditioned briefing room at Malaysia's Kuantan Air Base, about 150 miles east of Kuala Lumpur. While the three aviators discussed the day's mission and analyzed data from the two aircraft's computers, the F/A-18 and the single-seat MiG-29 were prepped for the next day's training flight.

For three weeks each summer, in an exercise known as Air Warrior, the aviators of a Marine Corps Hornet squadron duel with the fighter pilots of the Royal Malaysian Air Force, the only MiG-equipped foreign air force that Marine aviators train with overseas on an annual basis. Accompanying the Hornets to Kuantan Air Base are elements of a C-130J Super Hercules transport and inflight refueling squadron, part of an air controller squadron, and logistics support personnel. Each year a different Hornet fighter squadron arrives in Malaysia for the exercise; last year,



V. MiG

AMERICAN AND MALAYSIAN FIGHTER PILOTS GO HEAD TO HEAD IN A ONE-OF-A-KIND TRAINING EXERCISE.

STORY AND PHOTOGRAPHS BY ED DARACK

Marine Fighter Attack Squadron (All Weather) 225, based at Marine Corps Air Station Miramar near San Diego, California, was chosen to participate.

The U.S. aviators come to Kuantan realizing that because they fly more often than the Malaysians, they are more seasoned, particularly since almost all have actual combat experience. But Air Warrior focuses on air superiority sorties, which the Marine pilots have typically flown only against other U.S. aviators and aircraft. "I've trained against Air Force F-16s, F-15s, even the F-22 Raptor, but this

is the first time with the Fulcrum," says Shipley, the executive officer of 225 and a former Blue Angels demonstration pi-

lot. "It is just a phenomenal experience for us to see how a MiG actually performs." The experience might one day

In Malaysia, Marines found out how their F/A-18D Hornets (above, left) performed against Russian-built MiG-29s (above, right). Right: Two U.S. aviators showed a Malaysian pilot the layout of the Hornet instrument panel.





be critical for U.S. pilots, given that the MiG-29 is flown by various U.S. adversaries, including Syria, Iran, Cuba, and North Korea.

Air Warrior, however, is far more than a tactical exercise involving the forces of two friendly nations. The South China Sea is a region where the United States might engage an enemy in a future conflict, so it pays for the military to build allies there—the facet of Air Warrior that will pay the biggest long-term dividends. “By deploying to Malaysia, operating there, and then redeploying there, year after year, we’re not only honing our skill-sets used in that particular exercise, but build-

ing and bolstering our relationships in that part of the world,” says Lieutenant Colonel Rob Scott, chief of the future operations group at the Pentagon’s Plans, Policies, and Operations Department for the Marine Corps.

THE U.S. GROUND CREWS assigned to Air Warrior must prepare for a challenging tour of duty at Kuantan Air Base. Because there were no hangars available to the U.S. maintenance crews, they had to work outside in oppressive heat and humidity. Each day began early, with the maintenance teams wiping thick beads of dew from the Hornets’ canopies. By 9:30 each

morning on the flightline, every crew member’s olive drab T-shirt was soaked with sweat. By noon, the pounding sun had driven all but a few crew members into the shade. “One of the things the staff had to look out for was to make sure the maintainers didn’t become heat casualties—that they constantly were drinking water,” says Sergeant Major Ron Halcovich. “The maintainers, once they get working, will forget about everything else that is going on around them.” Fortunately, during the three weeks of Air Warrior, there were no heat casualties.

“This is comparatively an austere environment,” says Major Peter McArdle, 225’s maintenance officer. “It is more austere than Iraq, for instance, in terms of services available and conditions.” McArdle explains that air bases in Iraq, such as Al Asad, which is controlled by U.S. forces, are essentially kept to the same standards as those in the States. “Training in an aus-



The exercise in Malaysia offered most of the U.S. aviators their first opportunity to see a MiG-29 up close (above). The Hornet (opposite) has dual turbofan engines that generate a combined thrust of 36,000 pounds. The Marines brought their own tanker, a KC-130J (left).



tere environment is good for the Marines to learn how to operate with limited parts support, limited ground support, smaller ramp space than they're used to," says McArdle.

One of the greatest hazards for the Hornets during Air Warrior came from a virtually invisible source: FOD—foreign object debris. A close inspection of the Kuantan flightline reveals chunks of broken concrete every few feet. Most of the pieces are pebble size, but even a paper clip, if sucked into an intake, can destroy the turbine blades of a Hornet's engines, grounding the craft. Each day of Air Warrior, the Marines spent time doing "FOD sweeps," shoulder-to-shoulder walks to scan the pavement for debris.

MiG-29s, on the other hand, have special engine intake louvers that block foreign objects, so the Malaysians don't rank FOD removal nearly as high in priority as U.S. aviation units do.

IN AIR WARRIOR ENGAGEMENTS, each side consists of one to three aircraft; sometimes the two sides are equally matched

and sometimes they are lopsided, with one aircraft, for example, trying to defend itself against two opponents. Regardless of the number of aircraft, all engagements begin the same: After takeoff, the MiGs and Hornets climb to 15,000 feet. Traveling at 350 knots (about 400 mph), they maintain a separation from each other of about a mile. The agreed-upon "hard deck" lies 5,000 feet above ground level; if a fighter flies below 5,000 feet, it has "crashed." The two sides split, and once out of visual range, the high-G dance begins: Each turns toward the other, with each pilot trying to get a tactical advantage over the other, putting his aircraft in position to fire its weapons. (The U.S. fighters are equipped with Sidewinder missiles stripped of motors and warheads. The MiGs are flying "slick," without their usual array of air-to-air missiles.)

While each engagement evolves uniquely, both sides follow the same approach: Work the aircraft for all of its advantages over the other, and try to deny the opponent from working his advantages over you. Since the MiG-29 and F/A-18 are fairly evenly matched, victory usually boils down to pilot skill.

"The Americans have better radar, better weapons, so we try to get in close," says Major Patricia Yapp Syau Yin of the Malaysian air force, recounting a one-on-one engagement she had against a Hornet. "Try to defeat their radar capabilities by doing aggressive moves—zooming in.

The Malaysian pilots were grateful for the chance to practice aerial refueling (left). F/A-18Ds (below) are two-seaters: A weapons and sensors officer sits behind the pilot.

We have to try to roll in behind them, not roll in front of them. Weapon-wise, software-wise, they are one up. But power-wise, we are one up." The MiG-29N that the Malaysians fly has a top speed of Mach 2.3 and a climb rate of 65,000 feet per minute; the F/A-18D's maximum speed is Mach 1.8 with a climb rate of 50,000 feet per minute. The Hornet, however, is a more maneuverable aircraft, with a fly-by-wire control system and more advanced avionics and cockpit displays.

Captain Matt Wieand, a Hornet pilot who flew against Syau Yin, says: "You make the turn in and come into the merge, and you feel the adrenaline. It is like a high-speed chess game, and a little like a dance, that ultimately is all about energy management. You assess the MiG's status, and if you misjudge the MiG's energy state or its pilot's options, you can get killed. You can trade potential energy [altitude] for kinetic energy [speed], and you always have to be thinking ahead. In this business, airspeed is life."

Just minutes after training to shoot down one another, the MiGs and Hornets fly side by side, refueling. With a para-drogue-tipped fuel hose coursing behind the two refueling pods of a KC-130J Super Hercules, an F/A-18 and a MiG each plug in to refuel, with less than 50 feet separating the tips of the fighters' wings. Each Hornet fluidly connects to the fuel line; the MiGs, however, which have been retrofitted with NATO standard fueling probes, have a tougher time, though after a few jabs, most of them eventually succeed. "This was my first time [refueling during Air Warrior]—not that good an experience," says Major Nasruddin Khalid. "I plug in, and the hose disconnected. I tried twice until I reach my bingo fuel, then came back alone."

Major Josh Vance, the operations officer of the refueling squadron, points out that during some missions, three Hornets and three MiGs were flying just yards from one another off the rear of the tanker while awaiting clearance to connect to the fuel hoses. Tight formation flying, the MiG pilots' unfamiliarity with the KC-130J and the turbulence patterns generated by its six-blade propellers, and language issues (all Malaysian pilots speak English, but many have strong accents) make for an environment where a mishap—even a disaster—can





The Hornet aviators (in beige flightsuits) won most of the scrimmages last year, but the Malaysian pilots (in green) could improve their record after replacing their MiGs with the more advanced Sukhoi Su-30 (right).

happen in a fraction of a second.

But in the midst of the high-risk training and detailed coordination of aircraft and ground crews, the Malaysian and American aviators find common ground. “We talk the same language,” says Major Sebastian William of the Malaysian air force, referring to “pilot speak.” “Whatever we talk about is understood by both parties.”

“You have your comedians, your jok-ers,” says Marine Corps Major Chad Sund. “You have two groups of people who grew up in different cultures, but there are so many similarities.”

By the end of Air Warrior, the Marines had won virtually all of the air-to-air fights (with a few draws). But the Malaysians say they appreciate even the losses. “Every year we learn something new from the Americans,” says Major William. “With the limited number of assets, we can train only so much. Everything that we can take from the Americans, we will take.” The Hornet pilots too value the experience. “Training here is looked at the same way as training back in the States,” says Peter McArdle. “It doesn’t matter if we ‘killed’ everybody. We evaluate how we



did and try to determine if and how we could do it better next time.”

Though he has more than 2,000 hours in the Hornet, Shipley was grateful for the opportunity to rack up more air time. “It’s as real as it can get without an AIM-9 actually coming off the rail,” he says. “I was excited. The guy I fought was actually pretty experienced. He was [call sign] Taro. We’re more experienced than [the Malaysian pilots], as we do a lot more practice. But Taro did a lot of out-of-plane maneuvering, not often seen from the Malaysian pilots. He was really good.” Shipley hopes to participate in a future Air Warrior.

“These exercises are tremendously valuable,” says retired U.S. Army Lieutenant Colonel Ralph Peters, a global military strategist and author. “They strengthen alliances at both the political and practical levels, but they also allow us to iden-

tify and address a wide range of problems in interoperability, from fuel nozzle mismatches to radio incompatibilities—the sort of down-and-dirty details that can make a huge difference in a period of crisis. Human relationships remain critical in 21st century warfare, and these exercises do at least as much to build trust between individuals as they do to rehearse common flight procedures.”

The learning and bond-building will continue, but—starting this year—with new equipment: The Malaysians are replacing their MiG-29s with the newer, more advanced Sukhoi Su-30, a fighter/attack aircraft flown by a number of countries, including some with which the United States has had tense relations (China and Venezuela). While Malaysia is officially neutral, it certainly leans toward friendly these days—due in large measure to Air Warrior. ➤

SHUTTLES FOR SALE *PREVIOUSLY OWNED*

NASA'S AGING ORBITERS ARE LOOKING FOR A GOOD HOME.



Want the ultimate space collectible? Consider a space shuttle. The orbiters have flown 29 years and have a few miles on them (tens of millions), but soon all three will be up for grabs.

Sometime this year—right now it looks like September 30—NASA plans to shut down the program. For all the shuttle's successes in missions like deploying satellites, fixing the Hubble Space Telescope, and building the International Space Station, flying it was always risky. Two orbiters were lost, *Challenger* in 1986 and *Columbia* in 2003, killing 14 astronauts.

Now NASA says it will donate the ones remaining—*Atlantis*, *Discovery*, and *Endeavour*—to whoever it feels can provide the best homes. In 2008, the agency issued a Request for Information, and 21 institutions entered the competition. NASA won't say when it will ask for formal proposals or identify the candidates, but some have declared themselves, apparently feeling that if you want a national treasure, you shouldn't be shy about saying so.

NASA made it clear that contestants don't win simply by raising their hands. Only U.S. museums and educational institutions are eligible. And the gift shuttles will not come with the three main engines, making them lighter and thus easier to transport. (NASA plans to give away six to 10 unassembled engine "kits" to suitable museums.)

***Enterprise* found shelter at the National Air and Space Museum's Steven F. Udvar-Hazy Center in northern Virginia in 2003 (opposite and above). Unlike the once-forlorn Apollo-era Saturn V rocket (below, in Houston), retired space shuttles must be kept indoors.**



Also, you have to display the orbiter indoors. NASA clearly wants to avoid a repeat of the Apollo program's denouement, when the agency left its three remaining Saturn V rockets to decay outside for decades at its centers in Florida, Texas, and Alabama. These noble behemoths, once targets for pigeons, have since been restored but "certainly there was a lesson learned," says Valerie Neal, shuttle curator at the National Air and Space Museum, which owns the rockets. Spacecraft are fine in a vacuum, she points out, "but they don't do that well on Earth. Both NASA and the Museum were a little naïve."

Most important, acquiring a shuttle orbiter is expensive. NASA is requiring the winners to come up with \$42 million—just for shipping and handling. Orbiters are 122 feet long, weigh 151,000 pounds, and have 78-foot wingspans. Underbellies are padded with ceramic thermal tiles, which must remain intact. The spacecraft cannot be disassembled for transport.

The first \$6 million of the fee will reimburse NASA for the Boeing 747 that will piggyback an orbiter to the airport of choice—as long as it's one with a runway at least 8,000 feet long. NASA hopes to get all three piggybacks done by May 31, 2012. Everything

BY GUY GUGLIOTTA





Its 78-foot wingspan makes trucking the shuttle over most roads an all-but-impossible challenge.

after that is your problem, and the ante doesn't cover

any of it. You must get the orbiter to the facility you have built for it, clean it up, put it indoors, fix up the displays, train the guides, and set up the videos and other exhibit features.

The document warned that during the move NASA will not "remove light posts and traffic signals," a point that caused the Kansas Cosmosphere and Space Center to drop out. There were suitable airports in Salina and Wichita, but to reach the Hutchinson museum, the orbiter would have had to travel 50 miles over two-lane roads. "We didn't want to destroy a

highway," says Marisa Honomichl, the Cosmosphere's vice president of marketing and development.

NASA did not say what the \$42 million buys you, but most of the money will be used to "safe" the orbiter: doing such things as covering naked wires, loose gadgets, and sharp edges, and draining it of toxic fluids.

There are several ways to raise \$42 million quickly—a new tax, vanity license plates, a special appropriation. "We would welcome public funding," says Stewart Bailey, curator of Oregon's Evergreen Aviation & Space Museum. But if that doesn't come through, he says, "we won't be holding a bake sale."

The Evergreen museum is a non-profit owned by Evergreen International Aviation Inc., a conglomerate that specializes in air transport, air cargo, and ground infrastructure but that also owns vineyards, farmland, and pasture near its headquarters in McMinnville, about 35 miles from Portland.

Evergreen opened the museum in 1991 and now has more than 100 aircraft on display. Its prize attraction is Howard Hughes' *Spruce Goose*, an airplane with a wingspan wider than the Airbus A380's; it bought the flying boat from Disney in 1992. And it has a new 121,000-square-foot building just waiting for a tenant.

"We understand the challenges; they are very clear," says Bailey. "The orbiter is big, it's hard to move, and it's expensive, but we wanted to be ready, and we are." Evergreen barged the *Goose* to McMinnville, waiting for low tide to sneak the cargo under bridges.

On Earth, shuttles fly piggyback on a Boeing 747, with their three main engines replaced by a tapered, aerodynamic fairing. When *Endeavour* (right), NASA's newest shuttle, showed up for work 19 years ago at Florida's Kennedy Space Center, there were no plans for a retirement home.





The same technique should work for the shuttle, but if not, the company will figure something out. Moving big stuff, Bailey notes, is what they do.

Also unworried is the National Air and Space Museum. Based on the RFI, the Museum is virtually guaranteed first pick, and Neal says it plans to request *Discovery*, the oldest of the three shuttles. The Museum will almost certainly make its shuttle on display, *Enterprise*, available to another museum. Now at the Museum's Steven F. Udvar-Hazy Center, *Enterprise* was a prototype, flown only in atmospheric drop tests, not in space.

Still, for some candidates, it's not just about the money. New York's *Intrepid* Sea, Air & Space Museum, at the piers of downtown Manhattan, has in its favor location, a huge metro region, and legions of tourists. The museum would house the shuttle in a

glass enclosure on the end of Pier 86 at 46th Street.

The museum "is uniquely positioned to be the recipient of one of these national treasures," says Bill White, president of the foundation that operates it. Getting the money wouldn't seem to be a problem; the *Intrepid* foundation raised \$115 million for the recent overhaul of the carrier and its pier (see "Restoration: Cleaning a Carrier," Aug./Sept. 2008) and to cover two years' operating costs. Now the *Intrepid* is raising more for a shuttle; officials won't say how much.

On the other coast, Seattle's Museum of Flight has Bonnie Dunbar, a former astronaut, as president and CEO, and is located in one of the cradles of American aviation. And the museum butts up against Boeing Field/King County International Airport.

Dunbar says her museum is building an exhibit hall that could house the orbiter. As for the \$42 million entry fee, "It is twice as much as the new building will cost, and quite a surprise," she says. But she adds: "I think it's all negotiable—and it should be."

If so, Museum of Flight, with its larger market, might have an advantage over Evergreen, but Bailey remains undaunted. Evergreen built the new facility partly as a *Field of Dreams* impulse: If you build it, the shuttle will come. When it comes to exhibits, he says, "we don't do penny-ante stuff." Probably the right attitude. ➔

At the Kennedy Space Center, *Atlantis* is hoisted off its cross-country ride.

Oregon's Evergreen Aviation & Space Museum, which has Howard Hughes' *Spruce Goose* (left), is eager to display a retired space shuttle.



TOP: NASA; BOTTOM: EVERGREEN AVIATION & SPACE MUSEUM



Head Skunk

ON THE CENTENNIAL OF HIS BIRTH, TAKE ANOTHER LOOK AT THE MAN WHO CREATED THE LOCKHEED LEGEND. *by Peter Garrison*

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HE NAME OF THE SUPER-SECRET project was Suntan. It was to be the ultimate reconnaissance airplane, flying so high and so fast—it was to cruise above 100,000 feet at Mach 2—that detection would be unlikely and interception impossible. But it also would have been a giant winged thermos bottle, with a fuel tank full of liquid hydrogen at -400 degrees Fahrenheit and its outer skin baking at 350 degrees or more. A proposed hydrogen liquefaction plant dedicated to producing fuel for several of the airplanes would have sucked up 10 percent of the natural gas supply of Los Angeles in two years. Flying the highly unstable and explosive liquid to the airplanes' bases would have required a fleet of heavy transports. An accident with one of the transports would have made the *Hindenburg* disaster look like a campfire.

It was too much, even for the formidable head of Lockheed's Hogwarts-like Skunk Works. Kelly Johnson had accepted the U.S. Air Force challenge in 1956 with his customary take-no-prisoners determination; now, two years later, he had changed

his mind, and he told the Air Force that he thought the program ought to be scrapped.

And so it was. If Kelly Johnson couldn't do it, the Pentagon reasoned, it couldn't be done.

Clarence Leonard Johnson was born in 1910, the seventh of nine children, in Ishpeming, on Michigan's Upper Peninsula. His family, Swedish immigrants, was poor; their lives were only a step or two above those of frontiersmen. His mother took in laundry and the young Clarence sometimes delivered the wash on his wagon or sled. Ashamed of his

Kelly Johnson was in his 20s when he challenged the early design of Lockheed's Electra (left). The engineer had his first big hit in the P-38 (below), which sold nearly 10,000.



OPPOSITE: LOCKHEED MARTIN; LEFT: SI-2003-22800-A



Hall Hibbard (left), who had a hand in hiring Johnson, would later say, "That damned Swede can actually see air."

family's poverty, he kept to the back alleys on days when the streets were crowded. "I vowed that one day I'd return to Ishpeming not on the back streets but the best streets," he wrote in his 1985 autobiography, *Kelly: More Than My Share of It All*.

Johnson was an American stereotype: the poor but hard-working lad who makes his way to the top. Smart, talented, and intensely ambitious, he possessed the fleet-footed self-confidence of gifted youth. To be a character in a movie, he lacked only good looks; later in life he would be described as resembling W.C. Fields but without the sense of humor—not entirely fair, since he did have, though he seldom employed it, a dry and somewhat sarcastic wit.

Attending the University of Michigan on scholarship, Kelly Johnson—he had acquired the nickname in grammar school—studied aeronautical engineering and made spending money by developing stream-

lined bodies for various clients, including Studebaker, in the university's wind tunnel. In 1933, during his final postgraduate year, he and his professor, Edward Stalker, evaluated a model sent from the small California firm of Lockheed. Stalker judged the stability of the twin-engine, 10-seat airliner acceptable; Johnson disagreed. But the standards of the era were lax, and a university wind tunnel was perhaps loath to issue verdicts that would alienate clients.

After getting his master's degree, Johnson went to work at Lockheed as a tool designer. Ignoring elementary principles of office politics, he immediately informed the chief engineer, Hall Hibbard, that his Model 10 Electra was dangerously unstable. Johnson must have reeled off enough coefficients, and shown a strong enough grasp of practical aerodynamics, to make Hibbard suppress any impulse to fire the upstart on the spot. Instead, Hibbard sent the young apprentice back to the Michigan wind tunnel with the big Electra model crammed into the back seat of his car.

In a series of wind tunnel tests, Johnson removed the model's large wing-root fair-

ings and replaced its central vertical fin with smaller ovals set at the tips of the horizontal stabilizer. A natural arrangement for a twin-engine airplane, the design had been used before; it ensured that if one engine failed, the slipstream of the other would be blowing over one rudder, helping to keep the airplane flying straight.

Johnson's modifications solved the airplane's stability problems, and he returned to Burbank a hero. Leaving tool design behind, at 23 he joined the ranks of Lockheed's five other aeronautical engineers.

Despite his brashness, Johnson had a nerdy side. In his spare time he took classes at the California Institute of Technology, and he amused himself during vacations by solving practice problems in calculus and engineering textbooks. But he was also a flight-test engineer—the person who collects data during test flights—who joked that he needed one good scare a year to keep in touch with what he called "the concern of the pilot"—namely, staying alive.

Loughead Aircraft Manufacturing Company, founded in 1916 and renamed Lockheed 10 years later, had thrived during the 1920s by building fast, powerful airplanes for customers like Charles Lindbergh, Roscoe Turner, Jimmy Doolittle, and Wiley Post. Some of Johnson's time was spent supporting the technical needs of the company's celebrity clients. One of them was Amelia Earhart; the airplane in which she disappeared was a Model 10 Electra, and she and Johnson experimented with weight and balance, power settings, mixture, and altitudes to get maximum mileage per gallon. Later, when Lockheed developed the Constellation for Howard Hughes' Transcontinental & Western Air, Johnson would have more contact than he wished with Hughes, whom he detested and, incidentally, considered a dangerous pilot.

In 1937, the Army Air Corps published a specification for a high-altitude interceptor; Lockheed responded with a proposal for what was to become the P-38. Its twin-boom configuration, which is usually credited to Johnson although it could hardly have been adopted without the participation of Hibbard, was unusual but logical. As Johnson later pointed out, the amount of stuff—engine, radiators, landing gear, and turbo-supercharger—that had to go into the engine nacelles made

Lockheed called its early P-38 (YP-38, right) Atalanta. The Japanese called it "two fighters, one pilot."

them so long that, given Lockheed's fondness for twin vertical tails, it made sense to extend them another five feet to carry the empennage. The P-38 Lightning was Johnson's second big success; eventually, nearly 10,000 of the fighters were built.

Early in 1938, several Lockheed executives traveled to England to pitch a militarized version of the Model 14 Super Electra to the British, who were hastily restocking their armories. The executives took Johnson with them. The British were interested, but they wanted major changes. Working through a 72-hour holiday weekend with almost no sleep, Johnson redesigned the airplane and had weight, performance, and cost estimates ready on Tuesday morning. Though impressed, the Chief of the Air Staff, Sir Arthur Vimay, privately demanded the personal assurance of Courtlandt Gross, the Lockheed group's ranking executive, that the analyses of his 28-year-old designer could be relied upon. In those days, personal assurances meant something; days later, the Air Ministry ordered 250 airplanes. At the time it was the largest order ever placed with an American manufacturer. That year, Johnson was named chief research engineer.

Not only a designer and engineer, Johnson was a salesman as well, and an energetic promoter of himself and his ideas. He knew how to dominate meetings, even among military people who were themselves professional dominators. He became well known to the general staff of the U.S. Army Air Corps and Air Forces—the name changed in 1941—securing their confidence as much by his manner as by his achievements.

But he was still merely human. It was not until five years later that the Kelly Johnson of legend, the Superman of aeronautical engineering, came into being.

In 1943, the USAAF was becoming con-

cerned about Germany's development of jet fighters far superior in performance to anything the Allies had. A timid initial American experiment with jet propulsion, the Bell XP-59, had yielded an uninspiring airplane whose performance was inferior to that of propeller-driven types. Lockheed proposed a jet engine and airframe, and when Johnson promised the commanding officer of Wright Field in Ohio a jet airplane in six months, he had a letter of intent in hand within hours.

Johnson flew back to Burbank to present the project to Lockheed president Robert Gross. The company was working for the war; with three shifts a day, six days a week, it produced 28 airplanes daily. There was no space and there were no people for another project. But Gross, who thought Johnson walked on water, okayed the project and put him in charge of it.

Johnson went around the factory collecting people: "I simply stole them," he later wrote. He set up a secret shop beside the wind tunnel in a space walled with wood from Hudson engine crates and roofed with a circus tent. Once the facility had been set up, the time remaining for actual design and construction of America's first jet fighter was 150 days. This was not impossible; North American had designed and built the P-51 Mustang prototype in even less time. Johnson's team beat the deadline—and the budget—with what

The jet-powered P-80 fighter was the Skunk Works' first project. Lockheed president Robert Gross told Johnson, "I don't think much will come of this, but take it on."



LEFT: NASM-1B14798-A; TOP: HGC-967-A

would become the P-80 Shooting Star.

That was the beginning of the Lockheed Skunk Works, from which would emerge the F-90, F-94, F-104, and U-2, as well as a number of less-than-secret projects for which, during slack periods, the Skunk Works would produce prototypes. The Skunk Works put Johnson into a unique position among airplane designers. He may not have been more talented or insightful than the great designers at rival companies, but he now deployed his considerable managerial abilities within a secret castle in which his supremacy was unchallenged. His protected position and intimidating personality had the effect of

funneling all his subordinates' talents and achievements through him. Ben Rich, who went to work for Johnson in 1954 and became his protégé and successor, remarked that one thing you had to get used to at the Skunk Works was that all the airplanes were Kelly's airplanes. The story of the giant brain performing wonders in secret, like the Wizard of Oz, is an irresistible one, and over time Kelly Johnson became as much a myth as a man. "Kelly Johnson was my childhood hero," says Daniel Raymer, former head of advanced design at Lockheed. "I wanted to be either him or Tom Swift when I grew up."

By 1958, the Central Intelligence Agency had been flying the U-2 for two years. But the big spy plane was too easily detected by radar, and its only protection against fighters and missiles was the 75,000 feet at which it

cruised. A study of factors affecting radar visibility—these were the earliest days of stealth—had concluded that, because a faint, slow-moving blip became brighter with each successive sweep of a rotating antenna, a very fast airplane with low radar reflectivity would leave only a faint trail of widely spaced dots on a radar screen, and so stood a good chance of escaping notice.

The hydrogen-fueled Suntan project having been euthanized, the CIA now requested a conventionally fueled airplane of similar performance: Mach 3-plus cruise for 4,000 miles at extremely high altitude.

Under the internal name Archangel, Lockheed's ADP division—"Advanced Development Projects" was the official name of the Skunk Works—bounced around a seemingly random series of designs powered by jets, rockets, and ramjets or, in one case, all three. None of them was capable of the required speed, height, and range. Engineers might have dropped the project in frustration, except that at the time the Skunk Works had little else to occupy it.

ADP's ideas eventually converged, however, on a delta with two big jet engines and an extremely long fuselage with a peculiar cross-section. Both this design and the Convair division of General Dynamics' Kingfish—a delta with a faceted fuse-



To fly Johnson's high-altitude U-2 (below), pilots like Bob Schumacher needed a partial-pressure suit (left). The radical reconnaissance aircraft had a 100-foot wingspan; the F-104 (below, at left), nearly no wings at all.



LOCKHEED MARTIN (2)

lage ahead of its time—were presented to a CIA/Air Force/Department of Defense panel in August 1959. Both airplanes promised Mach 3.2 cruise at 85,000 feet. Although Convair's design looked good and the company had the experience of developing the supersonic-cruise B-58 Hustler, the contract went to Lockheed. The reasons for the decision aren't known, but the overriding one was undoubtedly the confidence of the CIA's "black operations" honcho, Richard Bissell, in Kelly Johnson, who was then at the zenith of his engineering powers and managerial skill.

The design presented two unprecedented challenges: aerodynamic heating—at the Blackbird's 2,000-mph cruising speed, the friction of air would soften and crumple an aluminum airframe—and making jet engines run at 80,000 feet, where the atmosphere has only one-sixteenth the density it has at sea level. Most aircraft projects, even pioneering ones, involve known materials and techniques, and make some use of the proven features of their precursors. The Blackbird was without antecedents. It required basic research in the fabrication of a new structural material, titanium; new fuel and lubricants; new fittings, wiring, and insulators; new sealants and fasteners; new nacelle designs and airframe aerodynamics; new ways to defeat radar; and new environmental systems to keep the pilot from roasting in his seat. The Blackbird remains, 50 years later, the highest performing jet airplane ever built: Nothing else has ever equaled its combination of speed, altitude, range, and, incidentally, spectacular good looks.

Kelly Johnson's Skunk Works was a revolt against the formalities of conventional industry. It was a throwback to a time when airplanes were created by small teams who all broke for lunch together. Johnson crammed a small number of capable people into close proximity, so that "engineering shall always be within a stone's throw of the airplane." He believed in the freewheeling inventive genius of individuals—particularly himself; he resented the intrusions of committees of government bureaucrats with their meddlesome meetings, and rebelled against their minutely detailed specifications.

He pared away procedural dross: What-



The Blackbird family comprised numerous versions; above, an SR-71A shows off its red low-visibility markings. At right: Ben Rich, hand-picked by Johnson to succeed him, won an aeronautics award for his design of the aircraft's propulsion system.

ever used up time without advancing the project was banned—even visits from the customer. Finished drawings were not required; shop men were encouraged to work from sketches and when possible to develop parts directly on the airplane. Decisions, once made, would not be second-guessed; good enough was good enough. Meetings were limited to two or three essential participants. Initial flight tests would be conducted by the builders—not, as was usual at the time, by the customer's pilots.

To the extent that an organization could, the experimental shop would behave like a single person. Its soul was Johnson, pushing, demanding, worrying, inventing. "Kelly's ghostly voice nagged at me during the fifteen years I occupied his big corner office," wrote Ben Rich in his memoir *Skunk Works*. "I always thought of the place as his, because his personality and character were branded on everything we did."



While the Skunk Works is usually viewed as a unique creation of Kelly Johnson's, it was so only in the context of a bloated American aerospace industry. France's Marcel Dassault used small, elite staffs in the same way that Johnson did, developing the Mirage IV supersonic bomber with a design team of fewer than 100. The revolutionary vertical-takeoff Hawker P.1127, which became the Harrier, emerged from a similar-size team of designers. Compared with the British or French, American firms typically employed two or three times as many people on a project.

The omniscient Johnson understood each man's job. He once scribbled in a project log, after visiting his engineers to determine what problems they were having,

TOP: JUDSON BROHMER/LOCKHEED MARTIN; BOTTOM: LOCKHEED MARTIN

"Most engineers considered they didn't have any, but after I suggested four or five each, they agreed." Some found him inspiring to work for; some found him tyrannical. Ray Goudey, a test pilot who also often flew Johnson in the company's jet, remembers him as "fun to be with." John Benson, who was head of propulsion at Lockheed during the Johnson era, recalls that the great man could make his staff uneasy: "I was in his office more than I wanted to be. He was a demanding person. I knew Ben [Rich] from way back and saw him as a friend, but not Kelly."

Given to displays of temper, Johnson used firing as a rhetorical device; one engineer claimed to have been fired several times in one day. Yet Johnson was tolerant of errors; what mattered was not that you had made a mistake, but what you did about it. His people were the best, and most were fiercely loyal to him. "I'm not sure how he picked his team members," says Steve Jus-

tice, who maintains Lockheed's archive of Kelly Johnson papers. "But he batted about .950. Without Kelly they didn't exist—and without them, he didn't."

Ben Rich described Johnson's ability to predict a temperature, weight, or pressure instantly and accurately, unlike others, who could only arrive at the numbers by long calculations. Johnson kept a bunch of quarters on his desk—they stood in for the proverbial chip on his shoulder—to pay off on a standing bet that if any of his engineers disagreed with him, Johnson would be right. Few quarters left his desk.

Johnson was not always right, but it did not always pay to prove him wrong. On the maiden flight of the U-2, Johnson instructed pilot Tony LeVier to land the tandem-wheel airplane on its front gear. LeVier tried several times, and each time the airplane bounced and started to porpoise. Finally, when the light was failing and rain was moving in, he did it the way many pilots

familiar with tailwheel airplanes would: He landed nose-high, the tailwheel touching first. It worked. At the first-flight celebration that evening, Johnson, who was a big man and strong, challenged LeVier to arm wrestle. Johnson won easily, then banged LeVier's hand against the table so hard that the pilot showed up for work the next day with his hand bandaged. A tipsy accident, perhaps, or perhaps just Kelly Johnson being sure he had the last word.

For the U-2, because of the extreme secrecy surrounding it, the Skunk Works expanded to become a production facility as well, and thereafter it sometimes handled the overflow from Lockheed's "white world" projects. Today, it is difficult to tell the extent of Johnson's participation in Lockheed's many aircraft. Lists of "his" airplanes often include the Constellation, on which he collaborated with Hall Hibbard, and the YC-130 Hercules, which he did not design and in fact disliked. "After Kelly started the



Skunk Works,” says John Benson, “he didn’t do the designs himself, he just had considerable input as to the aircraft’s design features. So he got the credit.”

Johnson’s crown jewel, the Blackbird, was, like any big airplane, a team effort. In his book, Rich describes the frenetic push to come up with the final proposal, and, as if to correct the notion that everything sprang fully formed from Kelly Johnson’s head, he names a dozen engineers and the designs for which they were responsible. Regardless of how much came from others, however, the Blackbird is always said to have been “designed by Kelly Johnson.”

Johnson was married three times. His first wife, Althea Young, was an assistant treasurer in the accounting department at Lockheed—she handed out the paychecks—when he went to work there. They were married in 1937; she died in 1969. The next year, Johnson, by his own account a “worry-wart” who had suffered from ulcers all



Appearing on “60 Minutes” in 1983, Johnson had achieved recognition rarely accorded an individual aircraft designer.

his life, had part of his stomach removed, leaving angina and heart attacks as his main health problems. In 1971 he married his secretary Maryellen Meade; a diabetic, she died in 1980 after a long illness. Within weeks, Johnson, after consulting Ben Rich about the propriety of doing so, married Maryellen’s friend, Nancy Horrigan.

Johnson had a busy life outside Lockheed. He and Althea built a house in Encino, in the San Fernando Valley, 10 miles west of Lockheed’s facilities. They kept horses, and eventually acquired a working ranch, Star Lane, in the Santa Ynez Valley, north of Santa Barbara. Johnson maintained his own farm machinery in a 4,800-square-foot shop that he had built, and whose huge size and strong construction were a source of pride for him.

Johnson never had children. Ben Rich, however, was something like a son to him. Rich’s son, Michael, remembers Johnson as an amiable friend of the family: “He came with us to Dodger and Little League games. I didn’t have the feeling that I was with a famous person. Later my dad told me: There were not many titans like this.”

By 1972, when Lockheed’s proposal for a lightweight fighter—essentially a rework of the F-104—was rejected in favor of General Dynamics’ F-16, the days were over when Kelly Johnson could pitch a vaguely defined airplane to a general and have a letter of intent handed to him. His powers as a salesman, which had served him

so well at the Pentagon and the CIA, were of little use in a world where, as Ben Rich wrote, “ideas were...a one-way street, initiated by Air Force planners with doctorates in flight sciences.”

Johnson retired in 1975, but remained a consultant and personal advisor to Ben Rich for years. He disliked Rich’s first big success, the F-117 stealth fighter, as did most of Kelly’s old guard. Kelly, says Steve Justice, “didn’t like ugly.”

In 1983, “60 Minutes” ran a segment on Johnson. He was 73 then, a grandfatherly figure, his old fierce energy tempered or concealed. He answered Morley Safer’s naïve questions decisively, and volunteered the opinion that the most important airplanes of all were cropdusters—a type he had never designed—because they made it possible to feed the world. Uninformed viewers could not have guessed what a colossus this amiable codger had once been.

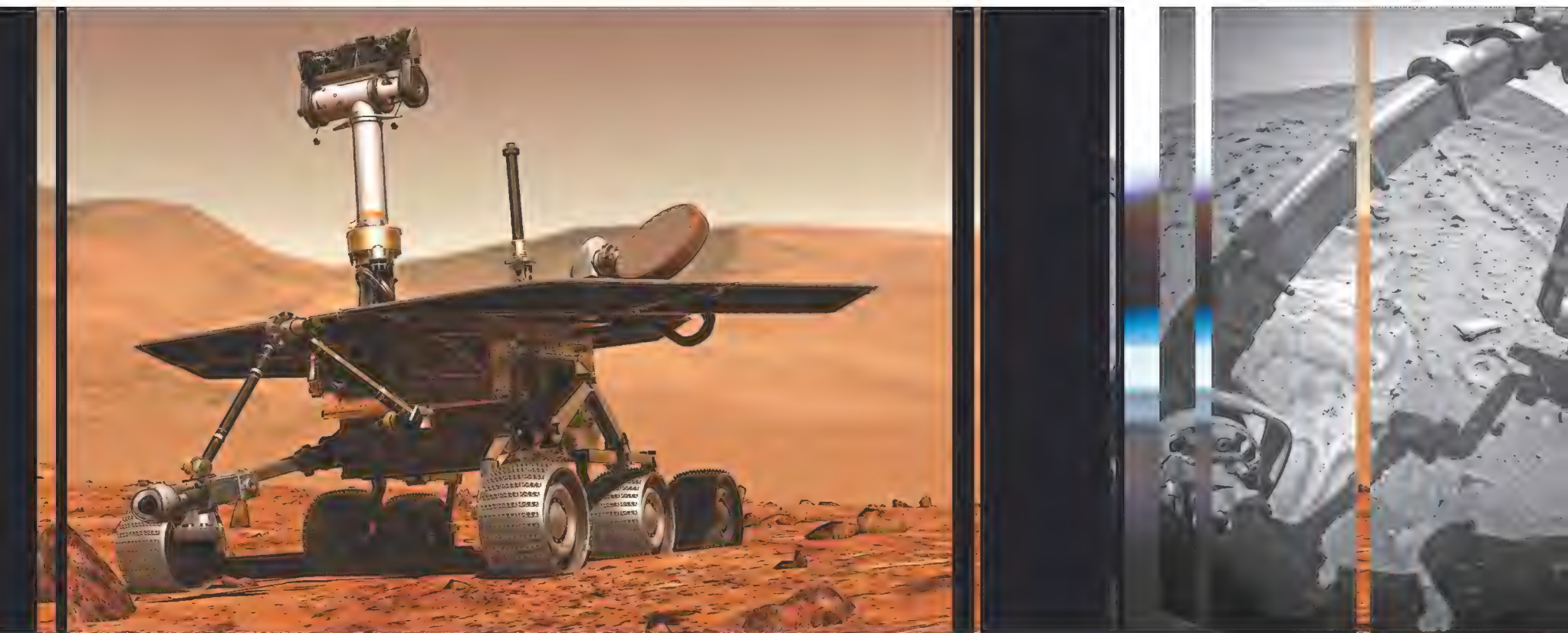
A catch, a stammer in his voice in that interview was perhaps the first sign of the dementia that would soon begin to devour him. Three years later, he fell and broke his hip. He never left the hospital after that. Increasingly eroded by senility, he lived another four years. The towering Kelly Johnson of legend faded slowly away; he died on December 21, 1990. He was buried in the foothills south of Burbank Airport, where his career began. There he sleeps, and the jets wheel overhead. ✈



Eleven of the 32 SR-71s built pose for a retirement portrait in early 1990 after program funding ceased.

OPPOSITE: ERIC SCHULZINGER/LOCKHEED MARTIN; TOP: LOCKHEED MARTIN

Our FAVORITE



IN THE SUMMER of 2003, NASA's Jet Propulsion Laboratory launched two robots to explore Mars. Named Spirit and Opportunity, they were born identical twins, but as they began to investigate opposite sides of the planet in January 2004, the four-foot-11-inch Mars Exploration Rovers developed distinct personalities: Spirit was a problem child and drama queen; Opportunity, a goody-goody and star performer. Both rovers, though, showed amazing durability. As the twins searched for water, they found the Fountain of Youth, living 24 times their intended 90 days. As they triumphed over one hazard after another,

BY MICHAEL KLESIOUS

sending back wondrous images from another planet, those of us watching from Earth began to root for them and to consider the robustness of their engineering as "pluck." In fact, when Spirit became stranded in deep soil last spring, the Planetary Society's A.J.S. Rayl blogged optimistically that clean solar panels had made Spirit flush with power, and she spoke for all rover boosters when she wrote that the twins were now among "the community of planetary explorers deemed robot royalty."

Maybe one reason for their success is that they're so light on their feet, each weighing 400 pounds on Earth but just 150 pounds on Mars, which has 38 percent the mass of Earth. Another reason is luck. Martian wind coated the rovers' solar panels with dust, ruining their capacity to draw energy, but then blew the dust off, enabling the solar cells to restore their vitality. And another reason is surely the ingenuity of the Jet Propulsion Laboratory scientists and engineers who built and operate the rovers, and have found clever ways to extend their lives as parts begin to break down. Whatever combination of luck and skill has made them successful, Spirit and Opportunity have deeply charmed the public.

One reason we're hooked is that once the mission began, anyone with an Internet connection could get images of Mars. "The policy on the [rover] team to release images to the public as soon as they came down was a novel move," says Janet Vertesi, a post-doctoral researcher in the Department of Informatics at the University of California at Irvine, who recently wrote her dissertation on the Mars Rover team's operations. It was one of the first times NASA released photographs

MARTIANS

A MODERN LOVE STORY.



so quickly, she notes. “I think there was this excitement about being able to log on to the Web with your cup of coffee each morning and see what’s on Mars that day. Now with Twitter feeds, Facebook groups, [and] blog posts, that has snowballed.”

Vertesi’s graduate research, conducted at Cornell University in New York, grew out of her interest in the history and sociology of science. She is intrigued by human-computer interaction, and is delving into the social organization of robotic spacecraft teams, examining how scientists use images to do their work, she says. The Mars Exploration Rover Mission was ideal for her work. She was able to observe team members using images to analyze Martian geology and to interact with the planet through the rovers from millions of miles away.

To understand the scientist-rover connection, Vertesi became a participant-observer alongside scientists and engineers on the team, both at JPL, in Pasadena, California, and around the country. A Canadian citizen, she was restricted in where she could go at JPL; for instance, she could not enter rooms where controllers were issuing commands to the

rovers. But she was given full access to the science team as they did their daily work on Mars, and got to know many science and engineering team members personally. (The science team is widely distributed, yet tightly woven through daily conference calls.)

She observed a complex relationship between the team and Spirit and Opportunity. “No one knows more than the drivers and scientists do that the rovers are not autonomous,” says Vertesi. “The team has to be very careful about what they tell them to do.” Her work, she states on her Web site, “brought up more questions than just about digital images.” At a 2008 conference in Italy, sponsored by the Special Interest Group on Computer Human Interaction, Vertesi presented a paper titled “‘Seeing Like a Rover’: Embodied Experience on the Mars Exploration Rover Mission,” in which she wrote, “While the Rovers are located millions of miles away from their human teammates, the scientists and engineers engaged in their daily operation have developed an uncanny sympathy for the Rovers that they credit as essential to mission success.”

For six years, NASA rovers have explored Mars (illustration, opposite). When Spirit got stuck in soft soil last spring (center, photo from last October), operators went into high gear to save it. Driver Scott Maxwell uses 3-D goggles to view the Martian surface on a computer, a key way to identify obstacles.



Engineers at NASA's Jet Propulsion Lab put two test rovers through an exhaustive series of maneuvers in a sandbox tilted at the same angle as the Martian terrain that trapped Spirit.

Team members are happy to talk about this relationship. "You're so involved with these machines that they sort of cease to be machines," says Sharon Laubach, who holds a Ph.D. in robotics and is chief of the JPL group that develops the software instructions for the rovers. "We send them commands, like letters and missives, and they do what they want and write home at the end of the day. These girls are off on their own, and we hope they do what we ask them to."

These girls. They're not the first machines to attract emotional attachment from their handlers. Laubach recalls developing a strong bond with Rocky 7, a test-bed rover that never left Earth.

Spirit and Opportunity, by contrast, have endured nights of temperatures at -150 degrees Fahrenheit. Since day two, Opportunity's arm has suffered a faulty shoulder joint. A bum wheel on Spirit has forced it to roll backward since 2006, while more recently, another of its wheels began having problems turning. In 2005, Spirit scampered up Husband Hill—at 269

Spirit was "failing to wake up" from regular midday "naps" that conserve power. There were "bouts of amnesia" when Spirit didn't record data from the day's activities into solid-state memory. Both rovers showed "symptoms of aging."

Laubach, who in the late 1990s worked on the Mars Pathfinder mission's Sojourner rover, says that tiny vehicle stirred emotions too. "I definitely grew attached," she says. "Sojourner was lower to the ground. Perhaps because of her size and limitations, I thought of her as a pet."

"Spirit and Opportunity"—she pauses—"are more human."

Then, it happened. In late April 2009, as Doug McCuiston, director of the Mars Exploration Program, says, "Spirit did the equivalent of falling through the ice." The rover inched up onto what no one realized was a brittle crust, and fell through into flour-fine dirt. In the low gravity and atmospheric pressure, the bone-dry fluff gulped the wheels down with each

effort to get out, while a menacing rock tickled the rover's belly. A 12-degree tilt didn't help matters. After Spirit's 40 months and 4.3 halting miles, at never more than 0.1 mph, the team declared a halt and spent half a year working with a full-scale simulation rover in a sandbox at JPL.

In late November 2009, the team began sending new commands to Spirit, to no avail. By late December, the rover had hardly budged. With the winter sun dropping steadily toward its solstice on the northern horizon, the southern-hemisphere-dwelling rover needed to find a slope that would tilt its arrays north. The team fretted anew that Spirit might not survive the winter.

"I think it's largely the time that people have devoted to this project that has really created this bond," says Ashley Stroupe, a rover driver. "We've been working with these rovers, some of us now, for 10 years,

Sharon Laubach claims that Sojourner stirred emotions too. "I definitely grew attached. Sojourner was lower to the ground. Perhaps because of her size and limitations, I thought of her as a pet. Spirit and Opportunity" – she pauses – "are more human."

feet almost the height of the Statue of Liberty—all on borrowed time. There the rover took inspiring panoramas of the Martian landscape that no one had anticipated. The same year, Opportunity got itself marooned in soft soil at Purgatory Dune for a month and a half. A year before that, Spirit had turned its eyes to the sky and taken the only picture of Earth from the surface of another planet.

Last spring, NASA put out a press release that framed the rovers' latest problems in unusually human terms:

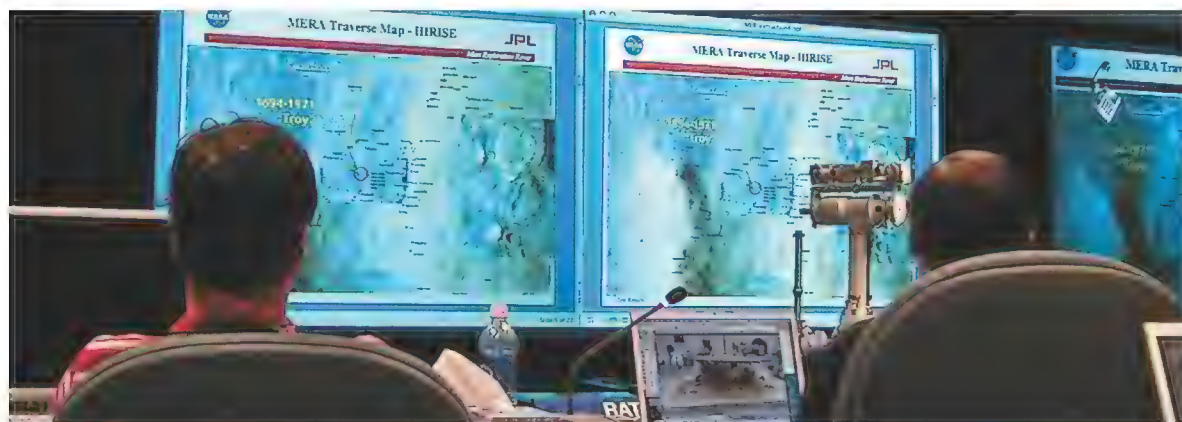
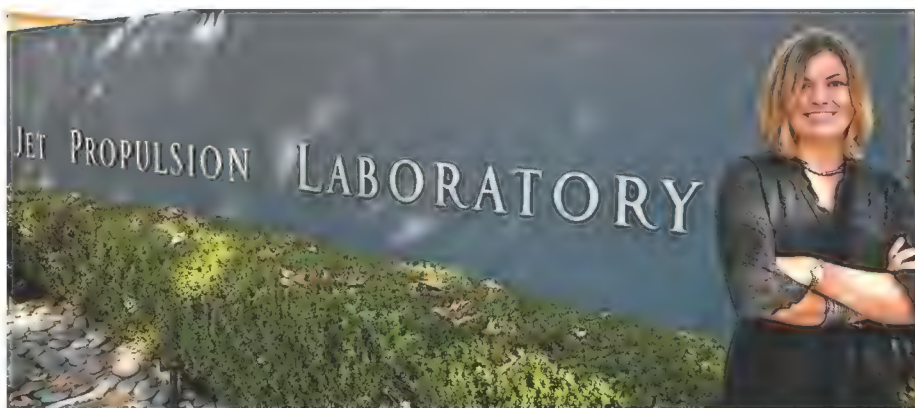
and myself for five.” Stroupe did not anticipate the affection she feels. “I didn’t know that I’d have the time to get to know the rovers this well.” She says that the team is emotionally invested in the welfare of the vehicles, that they’re “proud” of them. “In many ways,” she says, “we think of these rovers kind of as our children that we sent off into the world way too early. And like most parents, when their kids go off to college, we can’t reach out to help them every time that they really need us.”

Vertesi takes it one step further. In her “‘Seeing Like a Rover’ ” paper, she claims the controllers not only have an anthropomorphic view of the rovers, but also a “technomorphic” shift in their own behavior.

“It’s hard for us to understand the experience of these robots that are so far away from us,” says Vertesi. “So the scientists and engineers do the ‘rover dance.’ It’s a series of gestures that imitate the rover actions: unfurling of arms and rotating of wrists; splaying of arms behind them like solar panels. Always very aware of where the sun is. These people have a semi-physical presence on Mars. One scientist got up and was talking about an observation and he began to shuffle backward...and then he said, ‘Janet, get your

that record images in 3-D. “When I’m looking through these 3-D goggles, I’m looking at the Mars I would see if I were standing there and looking with my own eyes,” says Maxwell. “Then I can use all the stuff evolution put into my brain to think about that 3-D world...shape of the terrain, the height of obstacles, and so on, so that I can plan a safe path for the rover. It’s surprising how many dangers and insights pop out at you when you look at the terrain in 3-D that just aren’t apparent in 2-D. Try walking around for a day with one eye closed and you’ll see what I mean.”

Human-robot interactions create very real bonds. U.S. military personnel in Iraq and Afghanistan grow



Janet Vertesi (above) conducted a scientific study of the unique ways the JPL team interacts with the rovers. In August, the team (left) reviewed efforts to free Spirit.

camera. I’m turning into the rover!’ ”

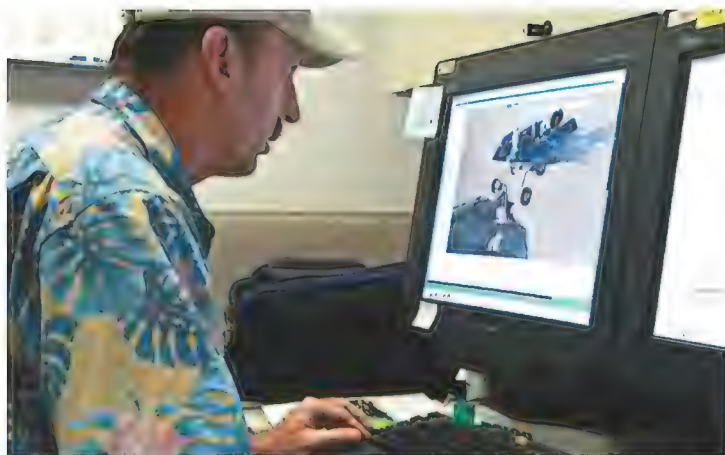
Driver John Wright confesses to some of it. “The thing I always notice is that I have to mentally visualize what the [rover] arm is doing. And I have to use my left arm. When I’m talking about it, I start with my right arm, and then I say, *Wait, I have to use my left arm*, because the shoulder joint’s on the left front side of the rover, and the elbow sticks out to the left. So you’re sticking your thumb out, wrapping the arm around. And turning the wheels. There’s definitely a lot of hand-waving.”

The Pancams are the eyes, says Vertesi, and they’re often talked about as such. “The rover team says, ‘We’ll look around a bit.’ When they look down, they say, ‘We’re looking between our feet.’ It pulls that rover down into the human space.”

And it sends driver Scott Maxwell up into the Martian space, thanks to pairs of cameras on each rover

attached to their comrade robots, which sniff out improvised explosive devices and often lose their mechanical limbs in the process. The machines get names, faux Purple Hearts, battlefield “promotions,” and major repairs—or somber memorials.

And there are increasing numbers of robots at home. A group of scientists at the Georgia Institute of Technology, which offers one of the nation’s top two robotics programs, recently produced a paper, “‘My Roomba Is Rambo’: Intimate Home Appliances.” Apparently the lowly vacuuming robot called the Roomba generates rover-like devotion. “The majority of our participants described Roomba as some form of household companion with lifelike properties,” the authors wrote, “such as ‘a helpful assistant,’ ‘a pet-like being,’ and ‘a valuable family member.’ Perhaps somewhat extremely, three participants actually listed their Roombas (including their names and ages)



Rover driver John Wright (above) watches a virtual rover perform trial commands prior to the real thing. Driver Ashley Stroupe (left) tests prototypes of future rovers.



as family members when we asked them to provide demographic information.... Eighteen participants felt that Roomba had intentions, feelings, and unique characteristics. One participant...felt that each unit had a unique personality although he was well aware that technology had not advanced that far...."

These military and civilian admirers get to touch the objects of their affection. By contrast, the JPL controllers get at best within 34 million miles of Spirit and Opportunity, once every two years.

"We imagine how the rover might feel," says John

Grant, a geologist and chair of the Center for Earth and Planetary Studies at the National Air and Space Museum. Grant is one of 14 chairpersons of the Science Operations Working Group, responsible for leading day-to-day science planning for the rovers. He's worked with the rovers since 2002. "I don't think of them as pets," says Grant. "And I don't think of them as people. But I definitely give them personalities." He thinks their mobility has something to do with it. "The Phoenix and Viking landers were tremendous successes. But they were stationary, so maybe they're more mechanical. Spirit and Opportunity, they're more like the Little Engines That Could, because they've done so many things we've asked of them that are beyond original expectations."

The mystique of the rovers has even touched Native American culture. Tim McCoy, a geologist at the Smithsonian Institution's National Museum of Natural History, has been on the rover team for the last four years. He's also a citizen of the Miami tribe from the Midwest. In their Algonquian language, explains McCoy, the Miami confer "animacy" on certain beings, such as people, animals, some plants, and some natural phenomena, such as thunder. "Anthropomorphizing is not the right word," he says. "It's hard to describe. Some things have a living force to them, a spirit of sorts." The Miami elders decide what types of modern technology have animacy. Cars do. Trains don't. "I had heard Janet Vertesi talk in a rover team meeting about the boundary in her mind between

John Callas (at left), the rover mission's project manager, says any Mars probe, roving or not, is a huge asset. Seismology and climate are two fields in which a stuck rover can continue to provide important science.





As the team set up another Spirit extraction test, team member Sharon Laubach (at right) brushed the test rover's wheel as it rotated last July, to make it sink faster. Matt Van Kirk manned the "kill switch," a safety measure always in force in case the team needed to halt a simulation.

people and machines," says McCoy. "She was sort of struggling with that. But from a Native American sense, there's no struggle there, no apparent conflict."

McCoy and a Miami tribesman colleague who is a linguist at Miami University of Ohio debated whether the rovers had animacy. They went to a tribal elder and described what a rover is and how it works with humans. The elder pondered the question, then proclaimed that the rovers have animacy. A group of about 20 undergraduates from the Miami tribe at the university then named the rovers "neehpikalaankwa keeyosia," or "the red star wanderer." "To the Miami," says McCoy, "the wanderer performs an important task as he or she gathers useful information during wanderings and brings it back for the community."

McCoy shared the story with the rover team. "They weren't surprised. You really feel like this thing is an extension of you. When one of them dies, there's going to be a tangible loss and a period of grieving."

End-of-life questions make anyone close to the rovers uneasy. Yet with Spirit's recent stranding, the scientists are often asked about the inevitable.

"They talk about them as geriatric," says Vertesi. "Amnesia. Arthritis. All very human experiences. But to mention a rover death.... The pressure to preserve the rovers is huge."

John Grant is practical about the demise of the probes, but says they're not there yet. "I know it will happen someday, but I don't want to think about the eventual end of the mission," he says. "With the rovers, it's open-ended. You don't want to let go of them."

A stationary Spirit or Opportunity is far from dead. Instead, the rover becomes like the Phoenix lander, which, after touching down in the Martian far north in May 2008, detected snowfall and clear evidence of water ice, and made it to early November, well

past its 90-day projection, before waning sunlight caused a loss of contact. Or it becomes like the two Viking landers launched in the mid-1970s, which studied the chemistry, meteorology, seismology, and magnetism of their Martian environments while searching for signs of microbial life, and lasted almost 10 years combined. Phoenix and Viking never budged from their landing spots. Spirit could be

"We think of these rovers kind of as our children that we sent into the world way too early. And like most parents, we can't reach out to help them every time that they really need us." – Ashley Stroupe, JPL rover driver

very valuable, say, as a climate station for months to come. "There's a whole list of geodynamic measurements that we can use that you need a stationary vehicle [for], to track the radio signals to explore the geodynamics of Mars," says JPL rover project manager John Callas. "And we also have an ability to do a crude seismometry with the rover. So those are both long-term objectives, new things that the rover can do." Bottom line: It's unthinkable that NASA would abandon a half-billion-dollar rover with almost all systems working just because it can't rove.

So while Spirit continues to worry the team, Opportunity has a good chance of surviving another Martian winter as it rolls south toward Endeavour Crater, its biggest crater yet. It will need more than one Earth year to get there.

When the fateful day comes and the Mars rovers cease to transmit, perhaps the JPL folks will be emotionally prepared, and will focus on Earthly companions: cars, pets.

"I have two cats," says Sharon Laubach. "Our rovers follow orders better than cats do." ➔



THE EIGHT-SEAT recreational airplane, a single-engine Gippsland Airvan, is cruising peacefully over southern Maryland on a hazy June afternoon, pilot and passengers enjoying the view from 4,000 feet, where the Nanticoke River runs into the swamplands at the edge of the Chesapeake Bay. Suddenly—*whoosh!* A trademark shape most of us encounter only in the movies or at airshows darts underneath the 100-knot pleasure craft, then carves a semi-circle in the sky in front of it. A voice crackles in the pilot's headset: "This is a United States Air Force armed F-16. You are in violation of restricted airspace. Do you require any assistance?"

No response from the Airvan. A minute or two later, the fighter is back, aiming for a more dramatic impression. It executes the "head butt," soaring up vertically within 500 feet of the intruder's nose. The voice in the earphones sounds less helpful this time: "This is a United States Air Force armed F-16. You have been intercepted. Please acknowledge or rock your wings."

The jet and an unseen wingman have scrambled from Andrews Air Force Base, just east of Washington, D.C. But their

WOULD A FIGHTER PILOT SHOOT DOWN A PRIVATE AIRPLANE? BY CRAIG MELLOW

controllers sit 400 miles north, outside the faded Erie Canal town of Rome, New York, amid a forest of glowing monitors at the headquarters of the Eastern Air Defense Sector (EADS). Yellow blips track every aircraft aloft east of the Mississippi River, several thousand on a typical weekday afternoon like this.

A general aviation airplane without a flight plan, chugging into restricted airspace, does not take long to stick out from the herd. If the Airvan continues to ignore the fighters in its face, EADS will pass an alert up a chain of command, where unspecified persons will have to decide what to do about it, perhaps within minutes, if the off-course pilot swings west toward the nation's capital.

This particular interception turns out to be a dress rehearsal. The Airvan's pilot and copilot are Bill Parris and Michael Regen, two Civil Air Patrol volunteers on a day off from their real jobs, as radio station owner and restaurant supply wholesaler. The routine is choreographed in ad-

vance with the Andrews top guns. "Nice work, braves," Parris compliments the F-16 pilots as the passenger airplane peels off toward its home hangar, at Martin State Airport near Baltimore.

This was practice, but the real thing happens often enough. One of the few detailed studies on the subject, a 2005 Government Accountability Office (GAO) report, found 3,400 violations of restricted airspace, or about three a day, in the 39 months following the September 11, 2001 terrorist attacks, which rewrote the rules of U.S. aviation. About 88 percent of the offenders were general aviation pilots, and seven percent were military. The most common reasons for infractions were pilots altering flight plans to avoid bad weather, or not keeping up to date on the shifts and expansions of the government's no-fly zones. The zones can change with little warning, as when the president travels. Nearly half the violations—43 percent—tallied by the GAO were in the Washington, D.C. area.



Most violators, of course, respond to a radio warning from Federal Aviation Administration controllers, and if not to that, then to the bright red and green lights used to flood the cockpit of intruders in the vicinity of Washington, and if not *that*, then to the Coast Guard Dolphin helicopters that sometimes precede the jet fighters. All the same, military aircraft have engaged interlopers “hundreds of times” over American skies since 9/11, says Davi D’Agostino, the GAO’s director of Defense Capabilities and Management. And defenders cite at least three cases last year alone when they feared they would be ordered to apply the ultimate sanction: annihilating a general aviation aircraft to stop it from committing a presumed terrorist act.

On April 6, 2009, what turned out to be a mentally disturbed young Canadian pilot entered U.S. airspace over Lake Superior without warning, and led Air Na-

A pair of F-16s from the Washington, D.C. Air National Guard patrol over the capital, which has more no-fly zones (opposite) than any other U.S. city. Pilot William Wales (below) learned this the hard way last April when he accidentally flew into restricted airspace.

tional Guard F-16s on a five-hour chase over four states before finally landing on a country road in Missouri. Minnesota Air National Guard pilots were the first to intercept the Cessna 172 near Michigan’s Upper Peninsula. National Guard units from Wisconsin and Louisiana took over as the pilot continued south without responding to the military jets.

“Failing to raise the off-course Cessna 172 on the radio, the F-16s improvised var-

ious stunts to get the pilot’s attention: firing flares in front of the renegade aircraft and flashing their landing lights,” recalls Colonel Joe Brandemuehl, commander of the Wisconsin Air National Guard wing that handled most of the pursuit. When the Cessna came within five miles of downtown Madison, the governor, on the recommendation of the Wisconsin home-

land security advisor, ordered the state capitol building evacuated.

The Missouri state troopers who arrested Adam Leon reported he was trying to commit suicide. “If he had turned toward Chicago, he would have gotten his wish,” says Gary Miller of the Federal Aviation Administration’s Office of Tactical Operations Security, who monitored the slow chase. “That’s the closest we’ve ever come to shooting down somebody on my watch.”

Just 18 days later, Maine retiree William Wales, flying down to see his daughter in North Carolina, strayed over Washington, D.C.’s restricted zone. Though repeatedly hailed on emergency frequencies by F-16s, he failed to respond, prompting a lockdown at the White House, preparations to evacuate the Capitol, and frayed nerves at EADS, whose staff flagged the incident to the North American Aerospace Defense Command (NORAD) in Colorado and braced for an order to fire. “Everything looked to be going against this man for a



while,” says Air Force Master Sergeant Michael Roberts, who was directing the interceptors from his chair in Rome that day. Wales finally saved himself when a Coast Guard helicopter flew by with a light board, a sort of neon sign, ordering him to call a certain radio frequency. He did, and was escorted to an airstrip out of harm’s way.

Last September, NORAD sent F-16s after a Mooney M20M that lost contact with controllers over Michigan and subsequently crashed near Muncie, Indiana. Military officials reported that the hobby pilot was apparently unconscious in his cockpit. He died in the crash.

Some people might say that sending a \$15 million fighter designed to outduel Soviet MiGs to interdict an off-course Piper Cherokee is using an awfully big hammer to hit a pretty small nail. These days, terrorism experts do not rank kamikaze attacks by general aviation airplanes high on their list of concerns. “You could do more damage with a Ryder truck full of fertilizer,” says James Jay Carafano, a home-

land security expert at the Heritage Foundation in Washington. When domestic airspace does need to be protected, other tools are more appropriate, he says, from helicopters to ground-based weapons.

Interceptions by military jets are not cheap. Flying an F-16 for an hour costs the taxpayer \$1,711, according to John Salvador, head of the Civil Air Patrol’s Missions Directorate. Not to mention the hours of practice beforehand. A major focus of F-16 pilots’ interception training is learning to slow their high-performance jets enough to read the tail numbers on pleasure craft going one-fifth their speed.

But few complain about the cost. Since 9/11, the U.S. government has been in no mood to take chances in the sky, or assume suicide pilots won’t destroy their targets. “A little Cessna with 250 pounds of explosives behind the pilot is all it would take to ruin Washington’s day,” growls the FAA’s Miller, mindful of the psychological as well as the physical effect that such a crash might have.

So, as the nation clamored for security after the attacks nine years ago, the Department of Defense launched Operation Noble Eagle, to expand its zone of protection from the U.S. border to the entire domestic sky. Pilots at Andrews and other bases across the land started drilling in deceleration and tail-number-reading. The FAA cordoned off protected air pockets over such potential targets as Disneyland and NASA’s Johnson Space Center. The rules aren’t always absolute. The FAA “strongly advises” pilots to avoid flying over power plants, dams, and refineries “to the extent practicable.” A short list of flat no-fly areas within the United States includes the houses of both ex-President Bushes, in Crawford, Texas, and Kennebunkport, Maine, and the Pantex nuclear assembly plant in Amarillo, Texas.

No city, not even New York, has the level of protection afforded to Washington. The nation’s capital boasts two concentric rings of restricted air traffic. The outer one is (or was) called the ADIZ, for Air Defense Identification Zone, which after a bit of pulling and tugging is now a simple circle of 30 miles radius with Rea-

Pull over, buddy: During a training exercise in Maryland last June, a U.S. Air Force F-16 “intercepts” a small aircraft piloted by volunteers from the Civil Air Patrol.



gan Washington National Airport at the center. Just as aviators were getting used to the term ADIZ, the government changed its name in 2008 to SFRA—Special Flight Restricted Area. Whatever you call it, in order to fly there, pilots have to file a flight plan with the FAA and obtain a four-digit transponder code for communications with controllers.

The inner, 15-mile circle around Washington is the Flight Restricted Zone, or “Freeze.” Three general aviation airports are still in business within the FRZ, but all pilots flying within the zone must be pre-certified. At Reagan National this involves finger-printing and background checks. Then there is the dreaded P-40, a circle around Camp David, the president’s retreat, 65 miles north of Washington, that is normally three miles in radius but expands to 10 miles when the president—or POTUS (president of the United States), as they call him in the bunker at Rome—is there. The FAA also regularly issues TFRs, or Temporary Flight Restrictions, most commonly linked to a POTUS visit to another part of the country. These are broadcast by NOTAMs (Notices to Airmen, a sexist holdover), which every pilot is theoretically required to consult before he or she takes to the air.

All the new regulations have collided head-on, metaphorically speaking, with the prevailing “Don’t tread on me” culture of general aviation, in which pilots cherish their airplanes as an embodiment of personal freedom. At Maryland Airport, a grass strip surviving among suburban McMansions in the town of Indian Head, just south of the FRZ, co-owner Gil Bauserman delivers a lengthy harangue against the federal “Gestapo” that terrorizes innocent fliers and is burying his business in red tape. “We had a retired Navy captain who lost electrical [power] and got intercepted because he couldn’t talk on the radio,” he recounts. “All of a sudden you have people jumping out of a Blackhawk helicopter with M-16s and the Indian Head sheriff’s department taking him down to interrogate him.”

The new rules are oppressive in subtler ways too, says Bauserman, who shoots the breeze in the airport’s haphazardly furnished office with his father and son, who are also his business partners. “So-called intentional violation of the SFRA



NORAD’s command center (above) was the first to notice a Cessna that led military jets on a three-state chase before landing on a Missouri road last April (below).

is a felony,” he rails. “That means a lot of our customers, who are government or military employees, could lose their jobs. But how often does somebody drive down the road and take a wrong turn?”

The testy rhetoric is harmless enough. But could a misunderstanding between defenders and aviators one day turn tragic, with some combination of failed equipment, pilot cluelessness, and itchy fingers in the Air Force leading to the death of a harmless hobbyist and collateral damage to anything in his flight path?

Military commanders acknowledge that there are specific triggers for destroying civilian aircraft, but they will not disclose them. Presumably they involve several factors, from type of aircraft to flight path to behavior of the pilot.

“There are very detailed rules of engagement to which we train on a routine basis,” Paul McHale, assistant secretary of defense for homeland defense, told the Defense Writers Group in 2005. He stressed that any decision to fire would not be made by the pursuing military pilots or their immediate handlers at Rome. “The authority to shoot down a civilian aircraft is delegated to a very small number of very senior

officials, civilian and military, within the Department of Defense,” McHale said.

The GAO’s D’Agostino assumes the circle is smaller still. “It would have to be the president or the Sec Def making the decision,” she says, employing Beltway-speak for the Secretary of Defense. “The U.S. military does not relish the thought of shooting down civilians.”

Last spring’s five-hour pursuit of the intruding Canadian shows the forbearance of the nation’s airborne defenders, and the wealth of information they can access quickly about a pilot’s background

and even state of mind. While the F-16s stuck with the aircraft, the FAA went to work identifying the violator from his tail number. He went by both his original Turkish name,

Yavuz Berke, and the Anglicized Adam Dylan Leon. At one point, the FAA brought in an FBI hostage negotiator to try (in vain) to talk the pilot down. Unnamed intelligence agencies cobbled together a quick psychiatric profile. “We had some information that he was depressed,” says Air National Guardsman Brandemuehl. Last August, the 31-year-old pleaded guilty to stealing an airplane and entering the Unit-



ed States illegally and was sentenced to two years in federal prison.

The unnerving part of the intercept picture is that, for all the whiz-bang technology at EADS, making judgments about objects in the sky while sitting on the ground still involves plenty of guesswork. The FAA's Miller reports that more than once Andrews F-16s have scrambled to arrest flocks of birds, particularly during autumn migrations.

Lt. Col. Paul Bishop, one of the EADS officers who take turns commanding 15 or so Air Force personnel in the LED-lit war room at Rome, recalls dispatching warplanes to intercept a speeding tractor-trailer on Interstate 90 in western New York state. EADS had picked up the truck on its radar scopes. On another occasion, F-16s were dispatched to a Temporary Flight Restriction zone set up to protect a space shuttle launch, and discovered a runaway Mylar balloon.

Less comically, the FAA shut down National Airport last winter and alerted the military that an unidentified "ultralight aircraft" from the west was approaching it and the nearby Pentagon. The threat turned out to be a group of George Washington University students launching a hang glider in poor visibility at dusk.

On other occasions, officials have been slow to react. When a pair of Northwest

Airlines pilots infamously overshot the Minneapolis airport by 150 miles last October—distracted by working on their laptops, they claimed—jet fighters were on standby, but never ordered into the air. Military officials said later that the FAA delayed notifying them.

What's certain is that even people who should know better continue to do stupid things in airplanes. Scouring his screens on an otherwise uneventful morning at EADS, Roberts spots an aircraft off the coast of Louisiana. There's something wrong: The airplane is using the generic transponder code 1200, forbidden in restricted flight zones—like this one, used for military maneuvers. If the situation isn't resolved in, literally, a minute, Bishop says he will have to declare an "unknown" and clear the room of non-essential personnel. But then the careless military pilot corrects his error.

A more obdurate intruder speeding toward Capitol Hill or Orlando, rather than wandering aimlessly around the Midwest, would force authorities to make choices quickly. A humble Cessna 172 can fly up to 140 mph, so from first breach of Washington's outer 30-mile security zone, the pilot could hit the Capitol or White House in less than 15 minutes. Even if the POTUS is not banqueting with foreign dignitaries and the Sec Def is not playing rac-

quetball, neither would have much time to make one of the most important decisions of their lives.

The bureaucratic flow chart for handling such emergencies looks more suited to lengthy debate than quick judgment calls. At least half a dozen federal agencies—the Department of Defense, the FAA, the Transportation Security Administration, Customs, the Secret Service, and the FBI—would have to consult in either of two electronic forums: the Domestic Events Network or the National Capital Region Coordination Center. The GAO report found one small problem: None of them was designated the lead agency.

When the auditors suggested to Congress that someone be put in charge, the Pentagon, straining English as only it can, "nonconcurred." Each agency has its own role to play, the defense department argued, and should not take a back seat to another for even 15 minutes. The military did fix other glitches identified by the GAO, like getting top FAA officials clearances so that NORAD software would not

Obvious enough? U.S. Coast Guard helicopters use light boards like this one to signal intercepted pilots. Right: A crew chief with the 125th Fighter Wing at Florida's Homestead Air Reserve Base rushes to his F-15 during a mock alert.



USCG/PAT JOHN EDWARDS



lock them out of kill-or-no-kill discussions. But the DEN and NCRCC remain leaderless to this day.

Frontline defenders of the skies seem slightly less reluctant than their commanders to pull the trigger in ambivalent circumstances. The crew members at EADS were pained by their inability to prevent the September 11 attacks, even though at the time monitoring domestic air traffic was not an Air Force mission. The welcome video shown to Rome's rare visitors dwells in almost lurid detail on the terrible events at the World Trade Center. The staff is grimly determined never, ever, to let anything of the kind happen again. "If the order comes to terminate one of these situations, I want to be the one in the chair," Roberts says. "Any of us would. That's what we're trained for."

"We try to scale back the DoD," says the FAA's Miller. "They like to be forward."

Even military intercept missions that

never come to the point of shooting can be dangerous, according to some civilians. "Having an F-16 fly past a GA plane and fire flares is a good way to start a fire," says David Wartofsky, co-owner of Potomac Airfield, one of the general aviation strips still operating within the FRZ.

Maryland Airport's Bauserman claims to have witnessed a near-collision between a Coast Guard helicopter and a Piper Cherokee 140 it was escorting to the ground (the Cherokee's pilot happened to work at the Transportation Security Administration). "The helicopter was in the Cherokee's path when it made a left turn to land, and the helicopter pilot had to fly underneath it to get out of its way," Bauserman recalls.

Yet even these libertarians admit that airborne security has become less heavy-handed with time. For one thing, the role of the F-16s' helicopter adjunct is no longer carried out by hard-ass Customs and Bor-

Right: An F-15 pilot with the 125th Fighter Wing answers an alarm during air defense training. In a real emergency, he might have just minutes to decide: "Fool or foe?"



LEFT: USAF/STAFF SGT. BENNIE J. DAVIS III (2)

der Protection squads in Blackhawks. "The Customs guys are used to confronting armed drug dealers and bringing a lot of force to bear quickly," says Wartofsky. Thus the M-16s at the ready to overpower hapless hobbyist pilots. Now the helicopter mission is carried out by amiable Coast Guard crews in Dolphins. "The Coast Guard is used to rescuing ships in distress, so they are a bit more constrained."

And some sources of confusion have been cleared up. Until August 2007, the 30-mile restricted area around Washington was an ungainly irregular shape variously nicknamed the Teddy Bear or Mickey Mouse. Now it is a near-perfect circle, harder to infringe upon accidentally. Gone too are the mini-TFRs that in the traumatized period after September 11 the FAA used to grant liberally. "For a while, any small-town mayor could call his Congressman and get a three-mile flight restriction zone declared because there was a football game on Friday night," Wartofsky says. "It was a nightmare."

So take heart that in the years since 9/11, there has been neither an attack nor a tragic misunderstanding. But if you are out flying, and you find an F-16 on your tail, do whatever the pilot says. —

Resto

Connecticut's State Warbird | Chance

IN 2005, the Connecticut legislature unanimously declared the Chance Vought F4U Corsair, the renowned World War II fighter with an inverted gull wing, its Official State Aircraft.

"It was a no-brainer," says Craig McBurney, a driving force behind the effort. "It's the only aircraft designed and built in one state by one major corporation in World War II," he says of United Aircraft, the parent company of the manufacturers that built the airframe, engine, and propeller. The Corsair would have needed long, and thereby heavy, landing gear to give the massive 13-plus-foot propeller ground clearance. So engineers canted the wings, allowing for shorter, lighter landing gear at each wing's low point. The F4U started life with the 2,000-plus-horsepower Pratt & Whitney R-2800 Double Wasp radial, which, at the time it was introduced, was the most powerful fighter engine.

Of more than 12,500 Corsairs built, fewer than 20 are flying today. "Even most people who don't know airplanes know the airplane," says McBurney.

He's speaking inside a World War II-type Quonset hut he re-created out of a

The Corsair was the first single-engine military airplane to top 400 mph in level flight.

hangar at Connecticut's Chester Airport, headquarters for Connecticut Corsair, the organization he founded to restore a wrecked F4U-4 he bought in 1993, registration number N5222V (originally Bureau Number 97330). The scarred mid-section of the fuselage is the largest piece. A canopy, wing ribs, and other parts hang from the ceiling. Others lie in crates stacked on shelves that reach the roof.

McBurney and his dozen or so volunteers are also digitizing some 20,000 blueprints with the help of modeling software SolidWorks and a scanning device at another company, Bolton Works. This enables 3-D modeling and computer-

aided design and manufacturing of new parts, as skilled workers able to make parts by hand are scant and expensive. About 30 percent of the airplane will be newly fabricated.

Yet the team will rely on some traditional construction techniques. "It's still hand-assembled, and the assembly sequence is critical," McBurney says.

Daryl Retzke and Matt Sandberg, 20-something engineers, display 3-D blueprints on a computer, which provide manu-



TOP: CAPT. LEE C. MILES; LEFT: JODY DOLE; RIGHT: CRAIG MCBURNEY

State Senator George Gunther, third from left, sponsored a bill declaring the Corsair the state aircraft. With him, the restoration team, from left: Phil Magwood, Daryl Retzke, Craig McBurney, Steve Ahern, Matt Sandberg. Below: Sandberg uses computer-assisted design tools.



restoration

Vought Corsair F4U

facturing instructions to a machine.

"For me, this project goes back to the roots of engineering," Retzke says. "This great airplane was designed by pencil and slide rule." Studying it piece by piece "makes me a better, more grounded engineer, basically bringing me back to the fundamental instruments and techniques used for design."

Retzke and Sandberg admit that technology drains some of the excitement. "Computers really take the fun out of designing stuff," Sandberg says. "[Today] you have software that can do stress analysis. Forty, 50 years ago, they set up giant rigs and did stress tests to see where parts failed" (see "Under Stress," *Then & Now*, Apr./May 2009). "I feel the guys who did that kind of work were on a higher level."

The Corsair's "official" status confers state approval for incorporating the pro-

ject and Corsair history into school curricula. The project has also established a NASA-funded engineering internship with the University of Hartford. McBurney wants to get Connecticut companies that worked on the Corsair—United Technologies, Pratt & Whitney, Hamilton Sundstrand, Sikorsky Aircraft, and others—involved in the restoration.

A Connecticut native, McBurney says his infatuation with Corsairs began as a youngster when he saw restored examples at local airports. And he liked "Baa Baa Black Sheep," the 1970s television series loosely based on Marine Major Gregory "Pappy" Boyington's Corsair-equipped "Black Sheep" Squadron of World War II. "It's the first airplane I admired," he says.

McBurney got his pilot's license in 1985 at a base fly-

ing club while serving in the U.S. Air Force as a gunner on B-52s. After discharge, he maintained and flew B-17, -24, and -25 bombers for aviation museums. Now he devotes most of his time to transforming the Connecticut Corsair into an ambassador for the state's businesses. Even if he nets a corporate sponsor soon, complete restoration of the airplane to flight-worthy status lies at least three years away.

"I tell the guys, 'Sometimes you have to put blinders on and ignore the big picture,'" he says. "That's the only way that we can keep working on this. It's such a phenomenal task, to have the audacity to think you can put something like this together."

JAMES WYNBRANDT

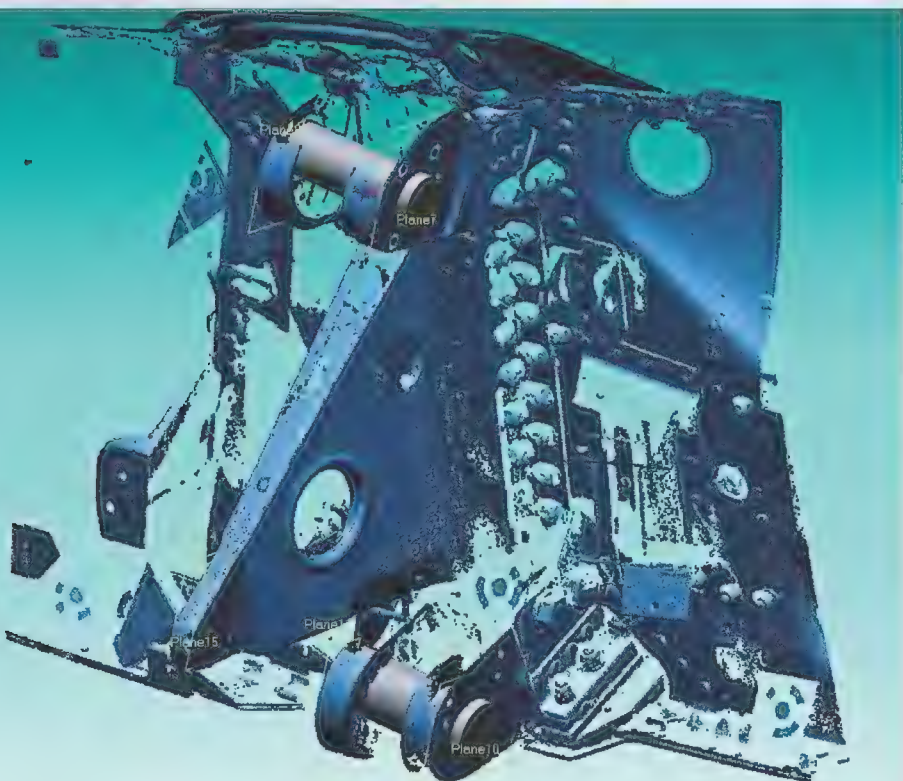
Four composite parts (right) for the airplane's main spar were rapidly produced to test fit, form, and function. Below: A white-light scan yielded a computer image of the main spar's wing attachment points.



CLINKENBEARD & ASSOCIATES



Everything in the hangar (above) is on wheels, such as a cockpit simulator, center, and McBurney, to its right. Below: The white-light scanner at Bolton Works images a piece of the main spar.



LEFT AND RIGHT: BOLTON WORKS; TOP RIGHT: JODY DOLE



The Other Harlem

At a small airfield in 1930s Chicago, blacks found the first schools that would teach them to fly. **BY GILES LAMBERTSON**



IN THE HISTORY OF BLACK AVIATION, it is Bessie Coleman, the first black woman to earn a pilot's license, who is usually remembered as the one who opened the skies to African-American aviators. Less well known is Cornelius Coffey, who, with much the same vision and

fighting the same obstructions, changed a corn patch in south Chicago into an airport that housed the nation's first large group of young, talented, and black aviators.

In the years just before and after World War I, some 180,000 black Southerners immigrated to Chicago, settling on the city's rough south side. It was there that Coleman, a Texas transplant who wanted to fly, learned that aviation schools didn't accept African-American applicants. She had to sail to France to earn a pilot's license. "Queen Bess" subsequently became the toast of the black newspaper *Chicago Defender*, and when she died in a fall from her airplane in 1926, some 10,000 black Chicago mourners filed past her coffin.

Coffey never met Coleman. The Arkansas native quietly mapped his own route to the sky. Young Coffey possessed a great gift for mechanical work. He was the top graduate in a south

Chicago auto engineering class in 1925, quickly earning the allegiance of Emil Mack, the white Chevrolet dealer who employed him. Coffey later found a spot at the dealership for a mechanic friend named John Robinson.

The two young men wanted to fly, but no one would teach them, so they taught themselves. Later, in 1929, they enrolled in an aviation mechanics program at Chicago's Curtiss-Wright School of Aviation. When they showed up for class, they were turned away because they were black, even though they had already paid their tuition. Mack threatened to sue on their behalf, and the school reluctantly admitted the pair. In 1931, the 28-year-old Coffey finished first in his graduating class and Robinson second. Two weeks

later, Coffey took the exam to earn his mechanic's license from the U.S. government. The school must have been impressed, because it changed its policy, inviting the men to return and teach all-black classes. They did.

The aviation mechanic's degrees didn't open many doors, however. Coffey and Robinson were still unwelcome at airstrips except Akers Airport, near where they worked, so when Akers closed, they were grounded. The men joined with several other local black aviation enthusiasts to form the Challenger Air Pilots Association (the name referred to the Curtiss Challenger engine). The new group looked for a place to fly from.

In 1931, the group, joined by one or two white pilots from Akers, bought a half-mile-wide tract of land in Robbins, an all-black town southwest of Chicago. There they buried boulders, dropped trees, roughly leveled the terrain, and cobbled together a hangar from second-hand lumber. When they finished, their small fleet of disparate craft—a Church Mid-Wing, an International F-17, and a WACO 9—was parked under the roof at what historians consider the first black-owned airport in the United States. The achievement is mostly a historical footnote: About a year later, a violent thunderstorm roared through Robbins, demolishing the hangar, flipping airplanes, and scattering hopes.

But a few miles north, at the intersection of 87th Street and Harlem Avenue in Oak Lawn, William Schumacher had purchased 140 acres of farmland with an



Coffey was the first African-American to earn both pilot's and mechanic's licenses. Below, Coffey watches a student prop a Piper J-3 Cub at the Harlem flight school, ca. 1940.

In 1935, a group of black pilots, mechanics, and aviation supporters (opposite) gathered at Pilgrim Baptist Church in Chicago to plan a flyover of the grave of Bessie Coleman, the first black woman in the world licensed to fly. Several of the group were part of the Harlem airport and its Coffey Flying School. Second row, middle: Janet Waterford; to her right, Willa Brown. Third row, far left: Cornelius Coffey; far right: Dale White. Fourth row, second from left: Harold Hurd.



TOP: SI-91-6606-P; BOTTOM: SI-86-6353-P



Chauncey Spencer Jr., whose father (right, with sister) flew to Washington, D.C., to lobby for the Army to train black aviators, teaches young students about such pioneers as Willa Brown, the first black woman to earn a commercial pilot's license.

airport in mind. His brother Fred would manage it. Before Robbins' devastating storm, Fred Schumacher visited Robbins and, probably sensing a good tenant, invited the group to come use his brother's airport.

After the storm, while Coffey was on a trip to Detroit, Robinson and two other Challenger members—pilot Dale Lawrence White and Curtiss-Wright school graduate Harold Hurd—approached Fred Schumacher to take him up on his offer. The facility was taking shape. Grass had sprouted where cornstalks had been plowed under, and a hangar and office sprang up along Harlem Avenue.

Schumacher readily agreed to rent the lower end of the airport to the Challenger group, but in an interview recorded for the Smithsonian Video History Program on black aviators, Hurd said that Schumacher initially insisted on segregation. He was already running an all-white school. "Look, fellas," he said, "I'm going to put you at the end of the field to save you from having any trouble with the other guys."

Black and white pilots parked their airplanes in separate hangars, but they shared Harlem's four sod runways, the longest of which was 2,000 feet. The rural area soon echoed with the thundering exhausts of Curtiss engines; the sky above the corn and wheat fields of Worth Township teemed with WACOs, Travel Airs, and

Taylor Cubs.

The leaders of the Challenger group were acknowledged to be Coffey and Robinson. Other than sharing a love of flight, though, the two men were remarkably dissimilar. Coffey was "a gentle man in every sense of the word," recalls Lynda Foose Hemann, daughter

The pair left Harlem in a two-place International F-17 owned by Challenger member and pilot Janet Waterford. At one stop, despite Coffey's protests, Robinson insisted on taking off from a short runway while weighed down with too much fuel, and the aircraft crashed. When the two men finally arrived at Tuskegee, administrators rejected their offer to set up a flight instruction program. Coffey was convinced that Robinson's loss of the International had ruined their credibility as proponents of flight.

(The following year, Robinson moved to Ethiopia to use his flying skills to fight



of Coffey's longtime friend, Marcellus Foose.

About five-foot-six and slightly built, Coffey had a large presence. He was formally uneducated, but contemplative. Quentin Smith, now 91, who learned to fly from him, describes Coffey as a person from "the old school. He never shouted. He never said a word that was foul. He always was quiet." The talented Robinson, on the other hand, was impulsive and self-promoting.

A 1934 incident well illustrates the differences between the two men's temperaments. On the 10th anniversary of Robinson's graduation from the auto mechanic program at the all-black Tuskegee Normal and Industrial Institute, Robinson asked Coffey to fly to Alabama with him to try to persuade Tuskegee administrators to teach flying.

an invading Italian army. He died there nine years later after a crash.)

At Harlem Airport, Schumacher asked Coffey to re-certify the overhauled aircraft of his white customers, enabling Coffey to begin earning money as a mechanic. It was the start of an agreeable working relationship with the man Coffey called "Shoes."

The Coffey Flying School operated on the south end of the airport, and Schumacher's school on the north. Coffey taught both white and black students together. "Every 10 students that I took, I had one white student and one girl student in that unit," he said years later.

One of those "girl students" was Willa Brown, a former Curtiss-Wright student of Coffey's. In 1938, the pert 27-year-old traveled to Harlem to take flying lessons

from her old teacher. Two years earlier, Brown, a former Gary, Indiana schoolteacher with a master's degree in business administration, had strutted into the *Chicago Defender* newsroom in jodhpurs and boots to promote an amateur airshow at Harlem. City editor Enoc Waters was so taken by her that he assigned himself to cover the event.

At Harlem, Brown became the first African-American woman to earn a pilot's license in the United States. She also became indispensable to Coffey's operation and to the black aviation movement. For a time, she also was Coffey's wife. In 1939, editor Waters proposed that the Challenger Air Pilots Association broaden its scope; within weeks the new National Airman's Association was chartered, with Coffey as president, Dale White as vice president, Brown as secretary, and Waters as the group's unofficial promoter.

Around this time, war with Germany loomed, and President Franklin Roosevelt proposed spending \$10 million to train civilian pilots for eventual induction into the Army Air Corps. NAA board mem-

bers feared that black aviators would be excluded. To get Congress to take African-American aviation seriously, the board decided to stage a publicity stunt: Some members would fly to Washington.

White and fellow board member Chauncey Spencer were chosen to fly the Lincoln Page biplane, powered by a Kinner 90-horsepower engine. Spencer served as navigator; White, in the rear cockpit, was senior pilot. Dressed in bulky cotton one-piece flying suits with white silk scarves and leather headgear and goggles, the two men departed Harlem Airport in early May 1939.

During the 3,000-mile round trip, the airmen made several promotional landings, but the trip's most significant encounter was unplanned. In Washington, D.C., the fliers and their local contact, Edgar Brown, president of a government employees union, were waiting for an underground train to get to a Senate office building when Brown realized the man standing next to them was the junior senator from Missouri, Harry S. Truman.

"Good morning, Edgar," Truman said. "Who are your two friends here?" Told of the flight from Chicago, Truman arranged to see their airplane later that day. For the rest of his life, Spencer enjoyed recalling how this unknown-to-him Midwestern

senator took one look at the Lincoln Page, turned to the two fliers, and said, "If you guys had the guts to fly this thing to Washington, I've got guts enough to see that you get what you're asking for."

Biographies of the future U.S. president are silent about the encounter, but students of African-American aviation cite it as an antecedent of Truman's 1948 presidential order fully integrating the armed services, and more broadly, the start of the campaign for full civil rights.

In late 1939, civilian pilot training sites were announced; they included seven for black students (Tuskegee, which had finally begun flight instruction, was one). The only black training site that was not a college campus was Harlem Airport.

Coffey was to direct flight training and personally maintain the aircraft of his renamed Coffey School of Aeronautics. Willa Brown would run a ground school at Chicago's Wendell Phillips High School and coordinate the overall program.

"Shoes" sold Coffey a 50-horsepower Piper Cub needed for primary flight training, and another white friend helped Coffey buy a second one. For secondary training, Coffey and Brown cajoled the Curtiss-Wright school into lending two 220-horsepower WACO PT-14s.

The Coffey school also would teach

At Wendell Phillips High School in Chicago, Coffey's instructors taught ground school and (here in 1941) aviation mechanics to adults.



SI-99-15431-P



During wartime flight instruction at Harlem, students learned on a WACO UPF-7 trainer; the field also had Piper Cubs. Below: Willa Brown (middle) with Perry Young, a Coffey pilot, and his mother, Edith, at Harlem in 1941.

cross-country and flight instruction; it and Tuskegee were the only black programs offering all four levels of instruction.

Each trainee received 35 hours of flight time. By June 1941, the school's fleet—mostly Cubs—had increased to 10. When rain caused excessive puddling on Harlem's sod runways, the students practiced from paved airfields in Harvey or Joliet.

Everything about the civilian pilot training program at Harlem was modest. Coffey and Brown lived in a small cottage at the southern tip of the airport, a building that doubled as the couple's Civil Air Patrol unit headquarters. Classroom work was conducted in a small one-room building crowded with student desks.

The government wouldn't fund student housing at Harlem, so in 1942 supporters of the program erected a dormitory: a cot-lined room, with adjacent latrines and showers. At one end, Brown supervised a dining area that served three meals a day to flight students and anyone else who wandered in.

"The atmosphere at Harlem was one of camaraderie," recalls Quentin Smith. He trained at the airport in 1942 at the invitation of Brown, whom he had known in Indiana. Smith says in his months at Harlem, all the student pilots had at least some college education and quickly bonded. "Every day it wasn't raining and we weren't flying, all we had to do was study," he recalls. "In the evenings, we'd get in the planes and get the feel of them. I probably wouldn't have made it without all

the camaraderie. I mean, out there we were so far from black people, we had to drive 20 miles just to see any."

To bolster the students' *esprit de corps*, Coffey and Brown procured olive green Civilian Conservation Corps uniforms. They also quietly used some of their own earnings to set up a pool of cash that the unpaid students could dip into for incidental needs.

Coffey remained committed to integration. When the Army Air Corps announced that the military unit from Tuskegee would be segregated from white servicemen, Coffey, speaking as NAA president, objected. "We'd rather be excluded than to be segregated," he declared. In the end, Army traditions prevailed. The Tuskegee Airmen would be a separate fighting unit, known informally as the Red Tails; their most famous mission was flying escort for bombers in Europe.

Smith remembers that Coffey and his instructors washed out few students, almost willing the young men and women to succeed.

Smith himself struggled until Brown rescued him. She asked Smith to go for a ride one day. Smith, who was six-foot-two and weighed 210 pounds, and the five-foot-two Brown took off in a Cub.

"She said, 'I've been watching you, Quentin, and I know you can learn to fly.



Let me show you something,' " he remembers. "She pulled it up into a stall and we spun seven or eight times—and you don't spin a Cub!—and then she pulled it out and this little lady said to me, 'You can't be King Kong, Quentin. You've got to be gentle. You're going to learn to fly today.'" And he did. Smith completed training at Tuskegee and was assigned to a bomber group based in Seymour, Indiana.

Bev Dunjill's connection to Harlem began in 1943 as a 16-year-old member of the Civil Air Patrol. He remembers Coffey as attentive. "He saw in me a kid who wanted to fly so bad he could taste it," says Dunjill, who at 82 lives just a few miles east of the old airport site. "He was a wonderful man. He was such an important person in my life."

Coffey offered to pay the black teen-

ager 50 cents an hour to work at Harlem, plus give him 30 minutes of flying time each weekend. Dunjill instantly accepted, though he didn't tell his airplane-fearing mother for six months. Each day Dunjill rode a streetcar to the end of the line at 63rd Street, where Coffey met him and drove him to the airport. The teen spent his days pushing airplanes from the hangar,

In the post-war years, Harlem Airport grew even busier, with six flying schools, a repair service, and half a dozen hangars. Forty acres were added, and 10 unpaved runways crisscrossed the field.

But in September 1956 the airport lost its lease. A parcel of land that had once been a cornfield was transformed once more, this time into a residential sub-

division and a shopping center named Southfield Plaza. Today, customers walk to Shop 'N Save, Hobby Lobby, and Walgreens on pavement where leather-helmeted pilots once revved engines to taxi and take off. Grassy airstrips scarred by ruts have disappeared under smooth streets lined with houses and trees. The acreage's only link to aviation is several hundred feet overhead, where airliners descend toward landings at Midway Airport.

For Harlem's entire 23-year existence, Fred Schumacher was manager, building his business on twin pillars: full service and a relatively enlightened sense of brotherhood. When the facility closed, he picked up and moved to Chicago-Hammond Airport. Probably the person in the best position to know, Schumacher told a newspaper reporter at Harlem's closing that some 350,000 hours of instructional flying had been logged at the rough field, a number that represented a lot of realized dreams, black and white. ✈

Harlem alumni
Quentin Smith (at left) and Bev Dunjill today. Despite Cornelius Coffey's pleas, the U.S. military kept African-American aviators segregated in World War II. Below, members of the black Tuskegee airmen unit in Italy in March 1945.



washing fuselages, and performing minor maintenance.

The exact number of pilots that the Harlem wartime program turned out is unknown, but it was in the hundreds. No airplane was ever wrecked.

After the war, Coffey did some work at Harlem, but spent most of the next two decades teaching aviation mechanics in high schools and an area college.

Some of the aviators from Harlem's early years went on to have distinguished careers. Coffey himself got a patent on a popular carburetor warming system, and the Federal Aviation Administration honored him with an aerial navigation waypoint ("Cofey Fix" in FAA spelling) to align aircraft landing at Chicago Midway Airport. Harold Hurd was inducted into the Illinois Aviation Hall of Fame. Dale White broke employment barriers for black mechanics. Willa Brown ran twice (unsuccessfully) for Congress, the first black woman to try for a Congressional seat. Quentin Smith stayed active in aviation, becoming president of the Gary, Indiana Regional Airport Authority. And Bev Dunjill, who had entered the cadet program at Tuskegee as World War II ceased, re-enlisted in 1949 and became an F-86 jet combat instructor in Korea, along with a pilot named Gus Grissom.



FIFTH IN A SERIES

LEGENDS OF VIETNAM

Bronco's Tale



THE U.S. MILITARY HAS BEEN HERE BEFORE:

fighting an enemy who wears no uniform, one who hits and runs then disappears, blending in with local villagers. It has pursued before, with overwhelming technological superiority, guerrilla fighters who improvise weapons and use the terrain to hide. The rugged mountains along

BY WILLIAM E. BURROWS

the Afghanistan-Pakistan frontier, where the Taliban and al Qaeda hide, are as effective at concealment as the dense swamps and forests of Vietnam, Laos, and Cambodia. In Vietnam, the U.S. military learned that when striking an elusive enemy, high-performance jet fighters were much more successful when they were directed by lighter, slower airplanes that could wait and watch for the enemy to move.

Last July the Air Force revived its requirement for a slow-moving, light-attack/armed reconnaissance aircraft, and Boeing's Global Services and Support group responded with an updated version of a Vietnam veteran: the OV-10 Bronco. In Vietnam, the OV-10 ("O" for observation; "V" for short takeoff) was highly adaptable and performed many missions for the Air Force, Navy, and Marines. But it was primarily a forward air control aircraft whose machine guns, rockets, and bombs could quickly make it ferocious.

"You could do quite a bit of damage while you were waiting for the heavier stuff," says Dennis Darnell, who in 1969 and 1970 was a first lieutenant in VMO-2, an observation squadron supporting the First Marine Division at Da Nang. "And if the situation was right, you wouldn't even need the heavier

COURTESY DENNIS DARNELL

stuff. You could get Medevac or troop transport helicopters in and pluck [U.S. infantry] out of difficult situations and that would be the end of it." The OV-10 was armed with four 7.62-mm machine guns and a variety of external weapons. For the Marines, the ordinary load was four rocket pods: two with white phosphorous rockets for marking targets and two with 2.75-inch, folding-fin rockets for striking them.

In 1971, 15 Air Force OV-10s with the 23rd Tactical Air Support Squadron, based at Nakhon Phanom Air Base in northeastern Thailand, were modified with laser designation pods and LORAN (long-range navigation) systems. The modified OV-10s would join the effort to interdict troops and supplies mov-



During the Vietnam War, the OV-10 Bronco served many masters. For the Navy, it flew light-attack missions. A forward air controller for the Air Force and Marines, it marked targets for fighter-bombers like the F-100 (left). Below: A target in the Quang Tri Province is hit by napalm dropped by an A-4E Skyhawk.

**OBSERVATION
WITH AN
ATTITUDE.**



TOP: COURTESY NATIONAL MUSEUM OF THE USAF; BOTTOM: COURTESY CHARLES BURIN



A Bronco returns to Udorn Air Base, Thailand. Both canopy doors are open to cool the cockpit. Left: At Da Nang, aircrew preflight an OV-10 armed with anti-personnel rockets, their proximity fuses visible.

ing on the Ho Chi Minh Trail, according to aviation historian Darrel Whitcomb, who flew those forward air control missions.

Forward air controllers, or FACs, are the flying equivalent of army scouts who range ahead of the main unit to locate the enemy and quickly report its location and strength. The FAC's mission is to call in artillery, fighter-bombers, or naval gunfire to reduce or eliminate the threat.

The FACs with laser designators illuminated targets for McDonnell F-4 Phantoms, at the time the only aircraft in Southeast Asia equipped with laser-guided weapons. On the OV-10, the LORAN "talked to" the laser designation system, says Whitcomb, so that pilots would receive a readout in the cockpit of the coordinates of the illuminated target. "The weapons systems guy in the back seat would hold

the designation system crosshairs on the target," he says, "and the bomb would come down and it would guide right to the target."

The control vanes on the bombs deflected fully or not at all, so the bombs would follow a zig-zag path. "I can still see it to this day," says Whitcomb. "The bomb came off the F-4, and you could see it wobbling—pitching up and down as it tracked to the target. Normally it took about 34 seconds to fall to the ground."

The Bronco arrived in Vietnam in 1968. It didn't take long for it to develop a reputation that made the Viet Cong think twice about shooting at it. "After a while, the enemy knew that it was a FAC aircraft," says Darnell. "We got cut some slack because if they missed, [they knew that] within a few minutes we could bring the world down around their ears."

"If a guy fired at us, the [pilot] would go into a steady orbit around the gun pit, and the bomb would come in," says Whitcomb. "And the enemy realized that if they saw an OV-10 go into a standard left-hand turn"—the pilot's maneuver to enable the backseater to designate the target—"they'd better stop shooting because they were about to get hit with a laser-guided bomb. And we used that as a defensive tactic: If they shot at you, just go into standard left-hand orbit."

"We lost some OV-10s doing that kind of stuff," he adds.

The reluctance of the enemy to fire was some-



Not-so-neutral Observer

With a bulging greenhouse canopy, the North American Aviation OV-10 Bronco gave its pilot and backseater a view of everything going on around them – and under them up to about 25 feet below the aircraft. The horizontal stabilizer, with a full-span elevator, sat high to clear access to the cargo compartment in the rear fuselage, which could carry paratroops or injured troops on litters. Low on the fuselage, sponsons provided a streamlined housing for four machine guns and attach points for other weapons.

times frustrating to the pilots, who were prohibited by the rules of engagement from attacking certain targets in Vietnam unless the bad guys fired first. So the idea was to get them to shoot. Gordon Evans, a Marine first lieutenant in 1971, remembers flying a patrol 20 miles west of Da Nang when he spotted a group of about 10 North Vietnamese soldiers lined up on a dike. He made a close pass to get them to fire. Nothing. He went around again. “They just didn’t pay me any mind,” Evans says. “They knew what was going on. So I went around to make still another pass, real slow. My backseater got agitated and said, ‘I don’t think this is a good idea. We’re gonna get hosed.’” But there was still no fire from the men on the dike. “I was all of 24, bulletproof, and knew everything,” he says. “I dropped my gear and my flaps, put all the lights on in the airplane—this is daytime—and went by in a landing configuration” to make the best possible target. He finally elicited a response. “Several guys on the dike pulled down their trousers and mooned us,” Evans says.

In the Era of Boom and Zoom

The Bronco was developed through a process unique in military procurement history. Two Marine Corps majors, K. P. Rice and the late William H. Beckett, were neighbors in Santa Ana, California, in 1961. (“K.P.” stands for Knowlton Prentice, which is “great for a Congressman,” Rice says, but “lousy for a Marine.”) The two had been in a Corsair squadron to-

gether in 1949, and, sitting on Beckett’s patio, they would discuss the Navy and Air Force preoccupation with sleek, swept-wing fighters and exotic weapons during what Beckett called “the era of boom and zoom.” They believed that the services were ignoring conventional weapons necessary for the close air support of ground forces.

What was needed, Beckett and Rice determined, was a scrappy observation airplane that could not only find enemy combatants but also attack them on the spot. They envisioned a twin-engine turbo-

The OV-10 was versatile. On some missions, Dennis Darnell (below) dropped seismic sensors with hair-like antennas that transmitted to aircraft monitors. The sensors picked up trucks or troops.



ILLUSTRATION: HARRY WHITVER; BOTTOM: COURTESY DENNIS DARNELL

The aircraft that began operations with the 19th Tactical Air Support Squadron in 1968 (right) was not exactly what K.P. Rice (below) envisioned in 1961, but it was close enough, he says.



prop that would be faster than helicopters, yet slower and more versatile than jets. And it had to be simple and easy to maintain. Furthermore—and this was revolutionary—the aircraft had to be

capable of taking off and landing in so short a space that it could be stationed with battalions in combat areas, not at some far-off air base. Each battalion would in effect have its own small air force. The two would-be designers limited the wingspan to 20 feet and the distance between landing gear to six and a half feet so that the aircraft could land on and take off from roads in undeveloped areas.

“Why don’t we build one?” Rice finally asked his friend. The two men built as much of a full-scale fiberglass model as would fit in Rice’s garage (because of the space limitation, attaching the wings was out of the question), and then began trying to sell the concept to “The System,” as Rice scornfully called the 1960s decision makers in the Pentagon and the aircraft industry. Their design was met with deep skepticism, partly because, unlike other attack aircraft, it didn’t carry tons of bombs. “We don’t want to do that,” Rice and Beckett patiently explained. “We want to base it with the troops and carry infantry ordinance.” They had in mind the 106-mm recoilless rifle.

The Navy fought the project at first, Rice says, but eventually came around, and so did the Air Force. In 1963, the services began writing requirements for a Light Armed Reconnaissance Aircraft. The Navy required landing gear that would enable the aircraft to operate from rough areas, and to test that capability, built a runway that looked like a sine wave. In a 2009 video documentary (made as a thesis for a master of fine arts degree by a student at the University of North Texas), the OV-10 gamely bounces down the runway’s hills and valleys as Beckett describes the test results: “The best pickup truck could do something like 7 mph on it before it went completely out of control. The OV-10 was supposed to land and take off on that. And they

could. The plane could do it, but the pilot couldn’t.” The aircraft shook so violently that the pilot’s vision blurred.

What was finally built—by North American Aviation, which, after a series of mergers, was later absorbed by Boeing—was a much larger aircraft (the wingspan doubled) with more systems than the two friends had originally planned. “But it was still recognizable,” says

Rice. “It could still be a pretty useful airplane.”

As Rice and Beckett had stipulated, the wings were set behind the narrow, tandem cockpit but even higher than in the original design, so they would not block the view of the ground or of anything lurking above and behind the aircraft. And the canopy was wider than the cockpit and bulged, which made the view spectacular.

Ready, 24-7

Appropriately, the first six Broncos that went to Vietnam were sent by the Marines and flew their first missions on July 6, 1968. An Air Force contingent arrived on August 1 and began operational missions a couple of weeks later. The Navy sent Light Attack Squadron Four (VAL-4), the “Black Pony,” in April 1969 to provide close air support for its “brown water” river and coastal operations, attack Viet Cong supply routes, and provide fire support for the SEALs.

“We had an aircraft in the air from six o’clock in the morning until right after sunset,” says Chuck Burin, a Marine aviator with VMO-2 in Da Nang who on a previous tour had flown A-4 Skyhawks. Today, Burin is the chairman of the board and historian of the OV-10 Bronco Association, a group of 400 veterans and Bronco fans headquartered in Fort Worth, Texas. The group has restored two Broncos for a museum displaying forward air control aircraft and memorabilia at Fort Worth Veterans Memorial Air Park at Meacham Field. One of them is an OV-10A that both Burin and Dennis Darnell flew in Vietnam.

With aircraft aloft all day—and crews on standby for night missions—a Marine OV-10 was always ready to support troops coming in contact with enemy forces. “We’d always have a crew on the ‘hot pad,’ as they called it, ready to go,” says Michael Cerre, a Marine tank officer who flew as an aerial observer. Marines who flew in the Bronco back seats were not aviators; instead they were infantry, artillery, or tank officers “who knew how to talk to guys on the ground,” Darnell says.

“On very-heavy-activity nights, we were sleeping under the wing of the plane,” says Cerre. “I can remember we used to wear [on lanyards] around our necks little plastic cheat sheets with the last coordinates we had for reconnaissance teams, so if they’d wake us to say, ‘You’re scrambling to support team Jolly Roger,’

I'd look down and the coordinate was right on my chest. We didn't want to waste a second. While the pilot was doing everything he had to do to get us off the ground, he'd say, 'Where we going?'"

The observer would be busy pinpointing the coordinates on a map and working the radios to find the fastest and safest route to the destination—around, over, or under artillery fire. "It was a really intense period of listening to a lot of voices from a lot of sources," Cerre says, adding that the experience helped him in his later career. As a broadcaster, "I'd have that link in my ear listening to the director yelling in all kinds of things and it was easy," he says. "It was only two people speaking." As a Marine observer in Vietnam, he had four radios, and was accustomed to hearing a lot more than two.

"The backseater could do what several radio operators on a C-130 could do," adds Jim Hodgson, who also flew the aircraft and is the executive director of the OV-10 Bronco Association.

The job was "locating the ground force," says Darnell, "isolating them on the maps, finding out what kind of a jam they had gotten themselves into, and then orchestrating whatever support was available at the time." When there was no action, a crew was assigned to a specific area for daily recon missions so they could become intimately familiar with it, and report any changes to the intelligence officers. "It was amazing that after a while you could tell if a stream crossing had been used or if vegetation had

changed," says Darnell.

Says Burin: "You'd notice everything: The farmers aren't out in the field today. Why is that?"

With external fuel tanks, an OV-10 could fly for five and a half hours. In addition to the four machine guns, which were mounted in sponsons bolted to the fuselage, there was a centerline station for a 20-mm cannon. The aircraft could carry up to 2,400 more pounds of rockets, bombs, or missiles on the sponson attach points.

"For those of us right out of pilot training, it was a slug compared to the T-38," says former Air Force pilot Brad Wright, "but boy, was it nimble. You could turn on a dime and make change. It wasn't sleek like a fighter jet, but it was plenty functional. It was a fun airplane to fly. It was responsive, fully aerobatic, had great visibility and good fuel economy." Like other OV-10 pilots, though, Wright says that the aircraft was seriously underpowered.

"You always want more power," says Burin. "I think the guys flying the F-22 want more power. But a number of OV-10s were lost in sloping terrain because they just couldn't fly out of it. And if

Pilot Gordon Evans at Da Nang between missions in 1971. Bottom: Two Broncos in a 1969 lineup at Bien Hoa Air Base, Vietnam, wait with cargo doors open. The aircraft could be loaded with up to 3,200 pounds of supplies or four paratroops.



TOP: COURTESY GORDON EVANS; BOTTOM: NARA

you lost an engine,” he continues, “if you didn’t dump everything that was hanging on that airplane, you were going to crash.”

Although the maximum altitude in the airplane’s published specifications is 26,000 feet, Broncos could work from the treetops up to only 18,000 feet “in optimum conditions,” according to Burin, “but we rarely flew above 10,000 feet.” Likewise, the aircraft could be considered a short-takeoff-and-landing craft, but it could take off in the advertised 800 feet only “with a light load on a cool day,” Burin says.

The Marine Bronco drivers and their backseaters ordinarily flew at 1,000 or 1,500 feet, so were most threatened by ground fire. The Air Force flew higher, at around 4,000 to 5,000 feet. “They had a lot more stuff shooting at them,” says Burin, referring to flights over the Ho Chi Minh Trail.

“At the start of the year I was concerned about [being hit by ground fire], but I guess I got over it,” says Jack Thompson, who was an FAC in Vietnam in 1971 and 1972. “It was almost a daily thing. I was there a year and I flew 234 missions, and so you get used to it. And the airplane, it’s like it was a part of me. It was slow and responsive.”

It wasn’t as slow as helicopters. Dennis Darnell, who also flew helicopters in Vietnam, much preferred the OV-10. “A lot of times if you were checking out, you’d go high and dive, and go by at a tremendous speed—a luxury you didn’t have in helicopters,” he says. “You were just always slow in those things. The reason I was so pleased with the OV-10 is I never had to put one in because of battle damage; whereas in four months, on my first tour I lost three helicopters.”

When a Bronco did need repairs, the work could

be done with ordinary hand tools. In addition, no ground equipment was needed to start OV-10 engines; and in an emergency, high-octane automobile fuel could be used in place of aviation fuel with only a slight loss of power.

The airplane did have a vulnerability, however: No Bronco pilot ever ditched the aircraft and survived. Aware that a pilot had been killed in an attempted ditching, Air Force Captain Steven L. Bennett chose to try anyway: in late June 1972 after a surface-to-air missile damaged his left engine and left landing gear. Bennett made the decision because the missile blast had destroyed the parachute of his observer, Marine Captain Mike Brown. Darrel Whitcomb was attacking enemy targets near the Demilitarized Zone when he got a call from Bennett. Whitcomb rendezvoused with the stricken aircraft and watched as it came down just off the South Vietnam coast. “By the time the helicopter got there,” says Whitcomb, “they were able to rescue the backseater, but Bennett was killed.” Bennett was the only OV-10 airman to receive the Medal of Honor.

What kept Bronco crews awake at night, says Michael Cerre, was the fear of directing an air strike or artillery strike on friendly forces or on civilians. “Was it the wrong bend in the river?” he remembers thinking right after the bombs had been released. “Was it the wrong hooch?”

“For the recon troops, we were calling for air strikes within 100 meters of them and that was terrifying,” says Cerre. “The jets would be coming in—they had to make these steep, tight turns—and the pilot would be saying ‘Am I cleared?’ but their wings would still be rocking and I’d answer ‘Negative, negative, neg-

Marines load 20-mm shells in the OV-10’s centerline cannon, which fired 200 rounds a minute with a kick so vicious it temporarily knocked cockpit instruments out of whack.



COURTESY DENNIS DARNELL



ative' because I had to make sure that the pilot had steadied his wings and had his sights on that target.

"And then there was this moment that haunts me to this day. [After the bomb was released] the radios would go silent. And you hope you hear the ground troops say, 'We're okay,' or 'That was on target.' But sometimes it wouldn't be okay. Either there was terror in their voices because the bomb had hit so close or the enemy was still coming."

Old Bronco, New Tricks

On February 23, 1991, the night before the Operation Desert Storm ground assault officially began, the First and Second Marine Divisions were already inside occupied Kuwait, breaching the minefields that Iraqis had laid. A holdover from the war in Vietnam was with them. Above the advancing Marines, an OV-10D—a Bronco with upgraded engines and a night vision system—monitored the ground action. The lead battalion, new to combat and moving fast in the dark, called in air support that could have hit friendly positions nearby. Captain Kevin Trepa, the Bronco observer who had a more complete picture of the battlefield, intervened and almost certainly prevented fratricide.

After Desert Storm, the Marine Corps decided to retire the OV-10 because its slow speed made it vulnerable to anti-aircraft weapons. (Of the 20 deployed in Desert Storm, two were shot down, both A models.) A flurry of articles in the *Marine Corps Gazette* worried that no airplane remaining in the inventory could perform the same mission as well. The Air Force's

recent call for proposals seems to validate that belief, at least in those combat areas without sophisticated air defenses.

Mark Pierce is leading Boeing's business development effort with the OV-10(X). "In theaters where the air defense threat has been peeled back," he says, "this would be a perfect platform to do convoy support or light-attack/armed reconnaissance at a fraction of the cost of what the [services] have been doing through F/A-18s, F-16s, F-15s, and A-10s." Though it would still be the same simple airframe, it would have a fully computerized cockpit, intelligence sensors, and a 30-mm gun in a centerline pod. It could also carry smart bombs and up to 16 Hellfire missiles.

Boeing is planning for a world market and hopes to sell upgrades to countries that have bought new and previously owned Broncos: Germany, Thailand, Venezuela, Indonesia, Colombia, and the Philippines. In the meantime, more than a few Bronco pilots and observers believe that if the U.S. Air Force needs a light-attack/armed reconnaissance aircraft, the one that performed the missions so successfully in Vietnam should report for duty. ✈



Chuck Burin in 1969 at Marble Mountain, a Marine air base on the Vietnamese coast. The Marines flew the first OV-10s to the base on the morning of July 6, 1968, and flew a mission the same afternoon. Top: A Marine Bronco heads inland from the South China Sea.

TOP: COURTESY GORDON EVANS; BOTTOM: COURTESY CHARLES BURIN

The GOLD-PLATED CABIN

WHAT RECESSION? THESE LUXURYLINER FIRMS HAVE MORE WORK THAN THEIR HIGHLY SKILLED CRAFTSMEN CAN HANDLE. BY ROGER A. MOLA



ENGINEERS AT LUFTHANSA TECHNIK

recently faced a tough problem: How do you install a 300-pound bronze racehorse in a large private jet? The client insisted that it be secured to the cabin floor by only one leg. Solving that type of problem can make a company's reputation in the demanding business of creating aircraft interiors for the wealthiest individuals in the world.

Luxury completions, one of the services provided by aircraft maintenance, repair, and overhaul facilities, is a global business, and currently one of the healthiest sectors of the aircraft industry. In one particularly active center, at EuroAirport near Basel, Switzerland, three companies employ 3,000 workers to complete new aircraft or to refurbish gently used ones, a process that can last two years and add 10 tons of innards to a hull that either arrives hollow or is gutted after it lands.

EuroAirport is one of the more unusual airports in Europe. Though it is situated entirely on French soil, just inside France's border with Switzerland, it is operated by both countries. Its location in the tri-national area of Alsace (the German border is not far away) is part of the marketing strategy for the three completions companies it hosts. They take advantage of the Swiss, French, and German reputations for precision and Old World craftsmanship to promote their abilities to install fine furnishings.

"In the French Alsace, and nearby in Germany, we have all of the talent we need in one area," says Heinz Köhli, one

Completions firms promise their clients white-glove treatment. At Lufthansa Technik's Hamburg facility, a worker installs a fixture in the lavatory of a Boeing Business Jet.

of the founders and chief executive of AMAC Aerospace. "That makes Basel unique."

The newcomer of the three firms, AMAC opened its completions center in November 2008 with 180 craftsmen. The company ex-

pects to double its workforce by this June, when it will have completed construction of a second hangar. The orders for completions that have compelled AMAC and its competitors—Jet Aviation Basel and Lufthansa Technik Switzerland—to hire more employees arrived one to

"In the French Alsace, and nearby in Germany, we have all the talent we need," says Heinz Köhli.

three years ago, when profits in the oil, mineral, and metals markets peaked, and newly rich magnates and governments bought airplanes. Aircraft sales have since slowed or stopped, yet each company, with a backlog that will keep it busy for several years, has been hiring. "At the moment the market is at a standstill, but I see stable growth for completions," says Köhli. "A year ago we would have said Russia has the most potential, but our main customer is now African governments, and we have some high-net-worth individuals. Some of them produce vodka, for example. But you cannot focus on a particular industry or region for growth." Certainly most at EuroAirport expect little business from the United States, where the economic downturn hurt corporate aviation more than it did in Europe.



In an AMAC conference room last spring, Köhli and Ruedi Kurz, who oversees maintenance and production, looked at a graphic representation of their company's work-in-progress. A box of

flat, black, magnetic airplanes was mounted on the wall next to an illustration of an AMAC hangar floor. An airplane silhouette was placed on every patch of floor, and each silhouette was marked with a tail number. To the right of the graphic, a glossy panel bore a blueprint of a cavernous new hangar AMAC was building. A year before that hangar's completion, its floor was also full.

"We did our build-out a year ago when the world was different," said Köhli. "Thank God we already have our pipeline of orders, and that we are lean and flexible." Kurz motioned to a real Airbus A320 in the hangar. "The customer signed the completions contract with us," he said, "though at the time, this site was nothing but cornfields."

The A320, which has since been delivered, had its registration number painted over, and when I got ready to take a photograph, I was directed to make sure that the tail number of its black miniature counterpart didn't show. Companies in the global completions business protect their clients' identities. Have your aircraft finished by any of these firms, and that's between you, a production man-

A Bombardier Challenger 850 executive jet gets a cabinet of fine wood veneer, made by Lufthansa Technik craftsmen. Finishes add tons to an airplane's empty weight.

ager, and a mushrooming family of specialists that includes woodworkers, upholsterers, plumbers, leather craftsmen, and engineers.

Most craftsmen start in the more mundane area of the business—the maintenance, repair, and overhaul that keep aircraft flying. They often then move up to finish the interiors of new commercial airliners. The most skilled workers build out the cabins of luxuryliners for wealthy individual clients.

“Our commercial work is still high-quality of course, but it’s fitness for a particular purpose,” says Clark Goodison, a Scotsman who manages the master craftsmen in the production support shops for Lufthansa Technik Switzerland. “You get on and off an airliner within two hours. You have your sandwich and the seats are comfortable enough. But the Sultan of Brunei, who might fly his aircraft four times per year, wants everything to be perfect. The VIP completion is about the precision. It’s the quality, it’s the finish, and a lot of the feel is artistic. Our staff look three times at a task before they decide to do it.”

To ensure consistent trade skills and promote a company culture, Lufthansa

Technik launched an apprentice program more than 50 years ago. This year, some 800 apprentices, ages 16 to 20, work in its German plants. Some, after completing internships subsidized by the German government, will work under a master for months to years before taking on a less supervised role in the company.

Karl Eikermann is the senior director of production at Jet Aviation Basel. “We tell recruits that in cars you only do production, and it’s always the same work. Here, you don’t see the same work twice,” says Eikermann. Most of the 60 specialists in the Jet Aviation upholstery shop came from automotive factories (a common recruiting ground for all three companies). The shop sews every stitch needed in the aircraft cabin, from the carpet to the sofa to the window shades to, for the very particular client, a fine fabric lining for dresser drawers.

Before any of the craftsmen begin work, however, interior designers determine the clients’ needs and desires. The consultation ordinarily takes months.

“Most customers know that they can’t bring their home designer and their yacht designer and directly translate that to their airplane,” says Bernd Schramm, AMAC’s chief operations officer. Every fabric or veneer, along with its adhesives, varnish, or paint, has to be certified by aviation authorities, who will subject the materials to burn tests. A material—leather, for example—is exposed to a flame for 12

Before Lufthansa Technik craftsmen can install lighting fixtures, they must make sure the finishes are flawless. Opposite: Jet Aviation constructed a full-size mock-up of a cabin interior in white styrofoam for a client’s designer to preview.



seconds. In that period, it must not catch fire. If it ignites after that, it must extinguish itself without intervention in less than 15 seconds from the moment of ignition, or the material cannot be used on an aircraft. If leather is mated with adhesive and veneer to form a headboard or office chair, the combination of materials must remain non-flammable for a full minute of exposure to fire, and any flame that appears after that must also burn out within 15 seconds.

“The most difficult to pass a burn test is animal horn,” says Eikermann at Jet Aviation. “And we have to burn-test every material, including stone veneer, which is the newest idea for vanity tops.” The veneer, made of minute flakes distilled from rare quarries, can be as thin as 3.2 millimeters, and is affixed to a featherweight metallic honeycomb. The stone veneer passed the burn tests.



COURTESY LUFTHANSA TECHNIK



COURTESY JET AVIATION

Exquisite leather covers a cushy seat in a Jet Aviation-finished cabin (left). Clients can select fabrics and marble to match (far left). To track the progress of a job, AMAC uses miniature airplane magnets (left, top).



LEFT: COURTESY LUFTHANSA TECHNIK; RIGHT: ROGER MOLA



Completions firms try to accommodate all requests. "Some customer may ask that all the controls on his main chair in the cabin for the entertainment system be transferred from the right to the left side, and that's just fine with us," says Lufthansa's Goodison. "Maybe he wants to sip his champagne with the other hand."

Part of the process may include constructing a full-size mock-up in white Styrofoam, right down to the king-size bed, conference room, and gourmet galley, to help the customer's designer picture the floor plan. At Jet Aviation, such a mock-up costs \$600,000 on average, and stays intact just long enough for a walk-through. Since most design is proprietary, and many furnishings unique, the mock-up is then destroyed.

Some requests just can't fly. Lufthansa Technik had to reject a Middle Eastern client's demand for an open flame in the cabin, reminiscent of a nomadic desert campfire. The company offered an alternative—an electrical appliance that created an artificial fire—but the project was abandoned. Jet Aviation worked exhaustively to craft a sofa designed like an

immense seashell, but could not build it to meet weight and height requirements, or the regulation that such seats must withstand 9 to 16 Gs.

But Lufthansa was able to make one dream come true: a night sky rendered in tiny diodes, to imitate a constellation the customer had enjoyed one special evening.

Once the aviation safety requirements

have been met, the craftsmen must meet a very high standard of quality. All work performed is checked, and checked again. Employees watch for the tiniest smudge on fabrics as they move from delivery dock to factory shops, and an elevator with a special speed for full loads prevents even a gentle

bounce at the bottom to keep from damaging delicate furnishings.

Many of the finishes are exotic. Eikelmann holds out a patch of steel-gray skin from an ocean stingray, which an Asian customer wants on his chair.

"Bubinga wood seems to be the thing now," says Clark Goodison, who as an amateur musician first saw the rare and costly grain on African drums. One project at Jet Aviation required a team of

artists from Eastern Europe be flown in for six weeks. They hand-painted a decorative pattern on a roll of Alcantara (a suede-like material) running 45 feet along the cabin ceiling.

"The most expensive finish is gold plate, but any finish can be costly depending on how many curves," says Eikelmann. Curved surfaces require more care to align with other layers as well as the underlying honeycomb of the furnishing and adjoining fixtures, and they take many more hours to seal and polish.

How much does it all cost?

Lufthansa Tech-

A rare photo of a finished VIP cabin, shot through a window, shows a typically glitzy interior, this one exhibited by Dallas Airmotive at a European aviation trade show.



JACK SYKES

"The VIP completion is about the precision," says Lufthansa's Clark Goodison. "It's the quality, it's the finish, and a lot of the feel is artistic."

nik offers a completion for the Airbus Corporate Jet or the Boeing Business Jet, with a cabin starting at six million euros (\$8.5 million). A high-end completion can add \$30 million to a hull that costs \$60 million empty, according to director of marketing and sales Thomas Foth.

"Of course this depends on the materials," explains AMAC's Ruedi Kurz. "One customer wants mother of pearl inlay on all of the cabinets. Another wanted all of the carpets to be silk, and that's another half-million right there."

"Smaller business jets can be completed in the lower eight-figure range," says Wolfgang Reinert, a spokesman for Lufthansa Technik. "The bigger an aircraft is and the more individual a customer's wishes are, the more expensive it will be." Wide-body hulls, such as the Airbus A340 or the Boeing 747, "can reach the nine-figure range."

No figures have been confirmed for the completion of the so-called "Flying Palace,"

Brocades and other fine fabrics are on display in the VIP completions design showroom at Lufthansa Technik, Hamburg. The company recently opened a similar facility at EuroAirport, near Basel, Switzerland, where it is hiring workers to create aircraft interiors.



a \$320 million Airbus A380 with an interior designed by British firm DesignQ for Saudi Prince Al-Waleed bin Talal. One aircraft interior design firm estimated that finishing the two-level, 6,000-square-foot interior will cost \$150 million.

Such high-profile projects—Prince Al-Waleed made headlines by becoming the first individual to purchase the enormous Airbus—may be good for business, but AMAC's Schramm says that word of mouth is the completions firm's best marketing tool.

"The customers know each other, and they know each other's pilots," says Schramm. "They go to the Gulfstream op-

erators' conference and the other operator groups. They go to EBACE [a European trade show]. They know who is getting service at each of our competitors."

"I have customers contacting me, I have

never contacted or heard of them," says Ruedi Kurz. "It's a different kind of corporation than a typical U.S. one. In these regions, it's more like a private family operation."

Although all three companies at EuroAirport have a backlog, they compete vigorously for

VIP customers. David Stewart, a partner with the forecasting company AeroStrategy Ltd, estimates that only five percent of worldwide maintenance, repair, and overhaul spending is for completing VIP aircraft. That means companies are chasing a piece of approximately \$3.3 billion a year, and maybe another \$1.5 billion for refurbishing and upgrades.

In a market where money appears to be no object, what makes a customer choose one company over another?

"We would not try to compete with others in this industry on price," says Schramm. "We would go by our quality and by the guarantee of our on-time delivery. We have comments from our customers that they feel taken care of, like a concierge service in a good hotel. Especially people in the Middle East, they want to come during our Christmas or New Year holiday and you have to find a way

"We have comments from our customers that they feel taken care of, like a concierge service in a good hotel," says Bernd Schramm.



LEFT AND TOP: COURTESY LUFTHANSA TECHNIK

With a poster comparing an impact driver with a hairdryer, Lufthansa tries to sell young people on aviation careers. The impact driver (right, in an AMAC shop) is ubiquitous in aviation repair and finishing work.



ROGER MOLA



COURTESY JET AVIATION (2)



Almost anything your heart desires is available from the firms that create luxuryliner interiors. Jet Aviation suggests installing a bar and casino (above, left) on one level of an A380. The company also offers a theater for the cabin of a 747-400, designed by the London firm Eidsgaard Design.

to support them.” Says Foth at Lufthansa Technik Switzerland: “We have an ambitious turnaround goal of four weeks for a VIP refurbishment. That’s 4,000 man-hours to remove all of the cabin, repair all of the components and re-install. There’s a dedicated team for each part. Even a base maintenance on a VIP cabin in this time is very ambitious. Generally [maintenance alone takes] six to eight weeks.”

How a company presents itself, says Lufthansa Technik’s Wolfgang Reinert, can also influence customers. When prospective clients visit the firms at EuroAirport, they see uniformed craftspeople at work. At Jet Aviation, the company uniform is an Old World-style French smock in navy blue. By contrast, the AMAC shop has a preppy J.Crew look: khaki shirts and gray trousers. At Lufthansa Technik, master craftsmen with special functions, like shift supervisor, wear white.

“You don’t want to brush against a soft hide in a dirty uniform, and dark colors

hide that dirt,” says Lufthansa’s Goodison in a sly poke at the others.

Managers repeatedly emphasize that their company’s competitive edge is the quality of work, and quality depends on the skills of the engineers and craftsmen. Anja Reichardt, Lufthansa Technik manager of personnel marketing and recruiting, says that if her company can’t recruit enough workers for the demand from the aviation industry, it will hire workers from similar professions like yacht construction and completing. What she looks for in a worker is accuracy as well as creativity and a sense of responsibility.

In addition, the company is trying to recruit the best workers through cooperative exhibitions and activities with schools and universities and through media campaigns targeting a range of ages: Some seek to interest seven-year-olds in the basic concept of flight; others try to

lure older students to start an engineering career with the company.

“We’re trying to make aviation sexy,” says Reichardt. “We put a lot of effort in the branding.”

Lufthansa Technik, for example, is assisting with the restoration of a

1950s-era Lockheed L-1649A Super Star. The aircraft is important to the company because in 1958, it became the first airliner operated by Lufthansa capable of crossing the Atlantic without refueling.


In Europe, the aviation industry com-

petes for engineers and craftsmen with the automotive industry. In surveys in which engineering students have stated preferences for places where they’d like to work, Lufthansa Technik is in the top 10 choices, but still falls behind the German automobile companies BMW and Porsche.

AMAC executive Heinz Köhli picked up skilled workers from automaker Peugeot, which last year cut thousands of jobs from its plants. Cutbacks at air force bases in both France and Germany also sent a stream of talent, he says.

“Everyone is stealing engineers from everyone else,” says Bernhard Conrad, Lufthansa Technik’s chief technology officer. The main challenge for the aviation industry, he says, is that “aviation begins with a fence around it, while you can go with your dad to the car dealer and see the oil being changed.”

After the Berlin Wall came down and the Eastern bloc’s aviation industry fell idle, Lufthansa Technik took over the Berlin-based, 500-worker maintenance facility of the former East German airline, Interflug. Conrad was impressed by how quickly the workers became adept at repairing Western aircraft. “The massive insufficiency of spare parts in Eastern Europe,” he says, developed in the workers “excellent repair expertise and great flexibility.”

Ingenuity may be the most important qualification for workers in the luxury completions industry today. That 300-pound bronze racehorse? Lufthansa Technik engineers found a way to install it in the private jet and still meet all the safety requirements. 

“We’re trying to make aviation sexy,” says Anja Reichardt. “We put a lot of effort in the branding.”

Reviews & Previews

BOOKS, MOVIES, CDs, STUFF TO BUY

Seaplanes in the Sun

A look at the early history of Florida's Embry-Riddle Aeronautical University, where thousands of pilots got their wings during World War II.



Embry-Riddle at War: Aviation Training During World War II

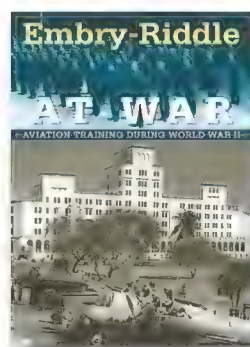
by Stephen G. Craft. University Press of Florida, 2009. 313 pp., \$34.95.

SIGN ME UP at the Embry-Riddle Seaplane School, out on the causeway to Miami Beach, in the 1930s. There are pontooned Piper Cub airplanes and all the fresh orange juice you can drink. The airplane ramps plunge into blue Biscayne Bay, the official school attire is “a tan and shorts,” and Florida’s 353 annual days of sun aren’t dimmed by gathering war clouds—yet.

The world’s premier aviation-

oriented university, Embry-Riddle Aeronautical University began as a south Florida flight school founded by John Paul Riddle. Stephen Craft chronicles the period from 1939 to 1945, when the school exploded from that idyllic “duck pen” seaplane base to become a flight instruction powerhouse. During World War II, 26,000 U.S. Army Air Force pilots and mechanics were trained at four Embry-Riddle fields around Florida, and one in Kentucky. Civilian instructors were lured by generous pay, swaying palms, and, sometimes, a draft deferment. But getting wings on green recruits was

A flight instructor demonstrates a maneuver with a model of a Stearman PT-17 trainer.



hazardous: Instructors’ logs frequently carried notations like “froze at the stick” and “emotional maladjustment to flying.”

Many a hell-bent, airplane-shy military cadet benefitted from a steady, experienced female civilian

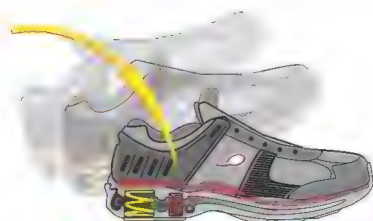
pilot. Women were actively recruited as instructors, pilots, and technicians. Hundreds of Royal Air Force cadets also soloed in the school’s steadfast Stearman PT-17s. The author engagingly details the

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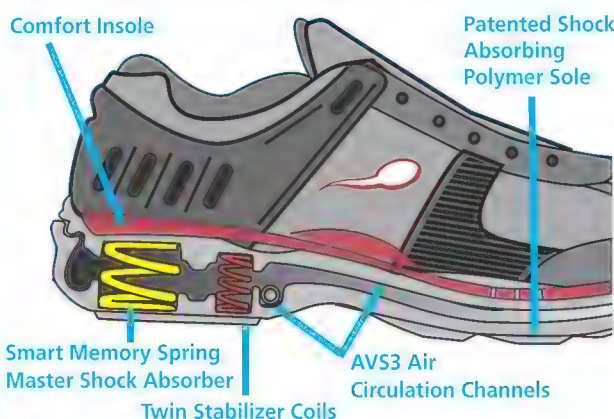
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culture shock resulting from Brits attending a U.S. school. “All American flying cadets have mechanical experience,” one Royal Air Force official said, but many Brits had never driven a car and lacked the Yanks’ intimacy with speed. To Embry-Riddle instructors, RAF cadets seemed initially clueless to the physics of motorized motion and asked “ridiculous questions.” Though eager to get into the air and gutsy once there, they struggled mightily with basics like taxiing. Societal momentum—such as the freewheeling spirit of American girls—threw some for a loop as well. One young Brit lamented, “In England, if you make a date with a girl, you don’t expect to see her with another chap the next day.”

Despite the Sunshine State setting, this is no beach book. Written in scholarly depth, parts are statistics-heavy. But quotes from the *Embry-Riddle Fly Paper*, the school newspaper, take the reader back in time and infuse many passages with humanity and wartime color. A school social at the art deco Macfadden-Deauville beach hotel is livened by the surprise appearance of mega-star Clark Gable—himself in town for Officer Candidate School—who delivers encouragement to the cadets before “battling his way out.” Above sun-and-fun Miami, “where no one is old and no one is shabby,” an RAF cadet muses, “Strange...to look out over this semi-sleeping city and think of men killing each other at that moment in a gash torn across Europe.”

When the national defense slogan was “Keep ‘Em Flying,” the school adopted its own motto: “Train Them Young.” During those perilous years, the students were, and Embry-Riddle did.

STEPHEN JOINER IS A FREQUENT AIR & SPACE/SMITHSONIAN CONTRIBUTOR.

>>> A Tale of Fliers and Farmers <<<

Barnstorming

Boru/Glenshaw Production. DVD, 49 minutes. \$19.95.

ON A SUMMER DAY 11 years ago, pilots Andrew King (who may be familiar to readers of this magazine, having done everything from Hollywood stunt flying to aircraft restoration) and Frank Pavliga were flying over eastern Indiana when they spotted an inviting field on which to land. The dairy farm, as it turned out, belonged to Matt Dirksen and family, who, after some initial skepticism, struck up a lasting friendship with the strangers who had dropped, literally, from the sky.

So began a years-long tradition chronicled in this documentary film, which celebrates flying, community, and the spirit of the American heartland. Filmmaker Bryan Reichardt (brother of *Air & Space* senior editor Tony Reichardt) and co-producer Paul Glenshaw have gone for a tone that is quiet and reflective rather than bombastic, which may explain why the film got such a warm reception at last year’s Film Festival of Aviation in Dayton, Ohio. As King says early in the movie, “I know people in the aviation world all over the place, and I’ve never heard another story like this one.”



DVDs can be purchased at www.barnstormingmovie.com.

>>> At a Glance <<<



Convair Deltas: From SeaDart to Hustler

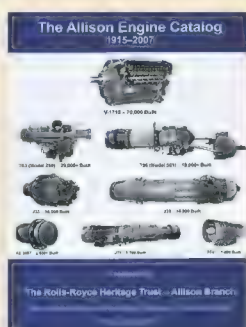
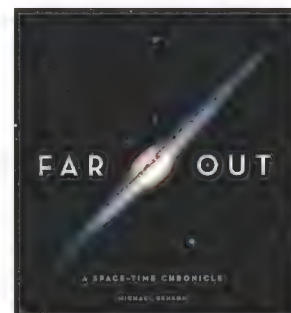
by Bill Yenne. Specialty Press, 2009. 216 pp., \$32.95.

A thorough documentation, through text and photographs, of Convair’s quest to conquer the aerodynamic mysteries of delta-wing aircraft.

Far Out: A Space-Time Chronicle

by Michael Benson. Abrams, 2009. 328 pp., \$55.

Capitalizing on observations from Earth- and space-based telescopes, *Far Out* uses more than 200 color photographs to take readers on a voyage into deep space.



The Allison Engine Catalog, 1915-2007

by J. Leonard. Rolls-Royce Heritage Trust, 2008. 292 pp., \$60.

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Brian Grote is a flight instructor with years aviation experience. He also writes monthly columns on subjects pertaining to aviation.

FLYBY

ARTICLE WRITTEN BY: BRIAN GROTE

Dear Brian,

I've been flying for over 20 years. My usual run is a Denver departure at 9pm, fly to Billings, on to Cheyenne and then back to Denver by 5am. I fly a King Air 350. I love my career and I pride myself on doing the best job I possibly can.

Last time out, however, I was making lots of little mistakes. I was cleared for the ILS Runway 35R into Denver, but I couldn't pick up ATIS. That's when I looked at my radios and noticed I had dialed in the wrong frequency. I glanced again and dialed in the right frequency. I continued through my checklist and set my Radar Altimeter to 5500 feet. I was ready to make my descent and start my approach. After the outer marker I glanced at my DH again and noticed that I had set my Radar Altimeter, 67 feet low. Luckily, I landed safely, bouncing the wheels just a little.

After a couple more days in the sky I could tell my eyesight was beginning to deteriorate. I knew I wouldn't be able to renew my first class medical if I didn't do anything about it. I was really worried and started asking my peers if there was anything I could do. A co-worker gave me a bottle of Claroxan™ and told me it would help me maintain my depth perception. I was skeptical at first, but tried it anyway. As it turns out, the stuff works great. The problem is, I ran out and don't know where to find more. Have you heard of this Claroxan™ stuff? Is it available in the States?

Jason, 46 – Seattle, WA

Jason,

Not only do I know of Claroxan™, it just so happens I take it everyday. Being a pilot myself, I know that perfect visual acuity is an asset none of us can afford to lose. That's why every pilot should be protecting their eyesight before it's too late.

Claroxan™ contains ingredients proven beneficial for the eyes. Among these ingredients are lutein and zeaxanthin – powerful antioxidants that have been clinically proven to protect the retina and macula and, in some cases, reverse the damaging effects of macular degeneration. These antioxidants block damaging UV rays and halt damaging free radical oxidation in the back of the eyes. They have also been clinically proven to decrease the risk of cataracts.

Claroxan™ also contains bilberry, an antioxidant known to improve night vision. Bilberry's night vision enhancing effects were first noticed in England in the early 1940's. The RAF ordered English fighter pilots to eat bilberry jam on toast figuring it would give them an advantage during night raid missions against the German Luftwaffe fighters.

Claroxan's unique proprietary formulation is completely safe, all-natural and extremely affordable. As far as ordering it, you can call them toll-free at 866.775.3937, or go to www.claroxan.com. I usually get mine within a week after ordering.

Hope this helps!
Brian

THE Himalayan CATARACT project

The Himalayan Cataract Project strives to eradicate preventable and curable blindness in the Himalayas through high-quality ophthalmic care, education, and establishment of a sustainable eye care infrastructure.

Based in Asia, at Kathmandu in Nepal, the Project is empowering local physicians to alleviate the suffering caused by blindness through unique programs including skills-transfer education, cost-recovery, research, and the creation of a world-class network of eye care facilities.

In years past, PacificHealth donated a portion of profits to HCP for development and construction of eye facilities in the Himalayas.

Visit CureBlindness.org to learn more about HCP.



CLAROXAN™ | LEADER IN VISION IMPROVEMENT

Sunlight, aging, and diet each cause damage to the retina and macula, which can lead to a decline in vision that glasses or contacts can't help. If you've experienced an increase in blurriness or have difficulty seeing details at any range, then you know how valuable sharp vision can be. What you might not know is that in the past three years, a flood of new scientific research has been done on natural vision enhancement. This medical research suggests that ingredients in Claroxan™ may help maintain and even improve your vision, while at the same time giving you added protection against many ocular diseases.

Claroxan™ may improve macular pigment density, which research shows has amazing effects on vision. By improving macular pigment density, ingredients in Claroxan™ may improve normal

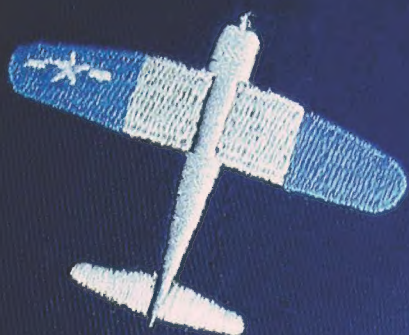
visual acuity, contrast sensitivity, and even glare reduction. Participants in one clinical study reported that ingredients in Claroxan™ improved their long range vision outdoors – in some cases, they were able to distinguish far away ridges up to 27 miles further than normal! Even if you have perfect vision now, Claroxan™ may help give you an edge by improving your visual reflexes and may allow you to pick up on moving objects faster than ever before.

People who count on their vision – people like pilots, hunters, military, and even pro athletes – trust Claroxan™ as the best source available for vision enhancement and protection. Claroxan™ is safe, effective, and extremely affordable. However, people with serious health concerns should consult a doctor before use.



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Reviews & Previews

Ambassadors From Earth: Pioneering Exploration with Unmanned Spacecraft

by Jay Gallentine. University of Nebraska Press,
2009. 544 pp., \$34.95.

CONTRARY TO THE REVERENCE

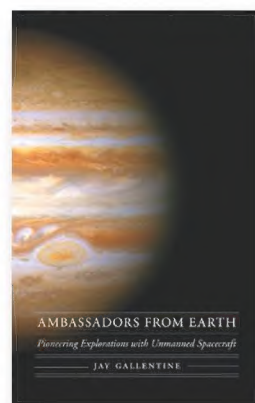
accorded the astronauts as space explorers, most exploration of the solar system has been done by small, ingenious, little-known robots sent as human emissaries to every planet circling our sun. Not since the last Apollo moon mission, in 1972, has a human engaged in any space exploration whatsoever. *Ambassadors From Earth* is a general one-volume history of these unmanned efforts to understand the universe.

The book has several strengths. The most significant is that it offers an accessible account of the U.S. and Soviet

planetary missions of the Space Race era, as well as the more widespread efforts of more recent times—an account that benefits from the release of documentary materials from the former Soviet Union. Additionally, author Jay Gallentine interviewed many people associated with the missions and quotes them liberally.

The book does have its shortcomings. The author writes in a jarringly informal manner: He refers, for example, to rockets as “doohickies” and “shiny new playthings.” The slangy prose seems especially inappropriate when narrating the history of one of the most modern and difficult engineering feats ever undertaken. More disturbing, Gallentine had the opportunity to provide sustained analysis, but failed to seize it. The book is a narrative only, and judged on that basis, it is successful. It will be of interest to space enthusiasts, but to those seeking anything deeper than “once over lightly” coverage of this important subject, it will be of only modest use.

■ ■ ROGER LAUNIUS IS A CURATOR AT THE NATIONAL AIR AND SPACE MUSEUM.



Forecast

IN THE WINGS AND ON THE WEB...

IN THE NEXT ISSUE

Air & Space Airshow Special **Happy 100th, U.S. Airshows!**

At the first U.S. airshow, in 1910, it was all about the airplanes – and a century later, little has changed. From the Pitcairn Autogiro to the Lockheed F-22, find out what you can see – and where – in 2010.



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Sky Snake: See how a 76-foot flexible airship competes in the world of unmanned aerial vehicles.

Credits

A Wright Relic Surfaces. Larry E. Tise is the Wilbur and Orville Wright Distinguished Professor of History at East Carolina University.

The Unhappy Bottom Riding Club. Norvin C. "Bud" Evans was a test pilot for the U.S. Air Force and civilian aircraft companies.

Tinseltown's Training Base.

Preston Lerner's last feature, "The Bear Is Back" (Oct./Nov. 2009), was about the Reno air races.

Hornet v. MiG. Writer and photographer Ed Darack wrote the book *Victory Point* (Berkley, 2009).

Shuttles for Sale. Guy Gugliotta is a writer in Pelham, New York.

Head Skunk. Peter Garrison's last feature on legendary engineers was about Richard Whitcomb (June/July 2002).

Our Favorite Martians. Michael Klesius is an *Air & Space/Smithsonian* associate editor.

Don't Cross That Line. Craig Mellow is a frequent contributor.

Connecticut's State Warbird.

James Wynbrandt lives in New York City and flies a Mooney M20K.

The Other Harlem. Giles

Lambertson's last piece for *Air & Space* was "Toy Story" (Oct./Nov. 2008).

Bronco's Tale. William E. Burrows is an *Air & Space* contributing editor.

The Gold-Plated Cabin. Roger A. Mola is an *Air & Space* researcher.

A Day at the Races. John Miller is the CEO of *TheArticleLibrary.net*.

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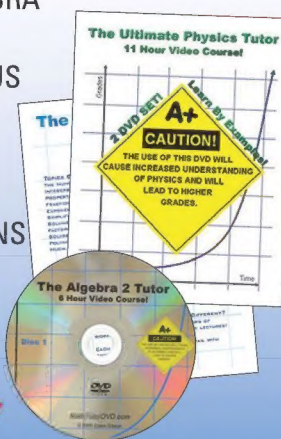
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A Day at the Races

THE WORDS “recreational flying” are rarely, if ever, found in the same sentence with “Boeing 737,” but while two South African aviation enthusiasts, Gavin Branson and Menno Parsons, were having a few beers last August, the combination became strangely plausible.

Branson is the CEO of a charter company, AirQuarius, which owns several Fokker F28 and Boeing 737 passenger jets. Parsons, an electrical engineer, owns a couple of airplanes, including an Aero L-29 Delfin.

Parsons likes to compete in air races, so he was interested to hear that the Rustenburg Flying Club (a small group about 90 minutes from Johannesburg) was organizing a Fédération Aéronautique Internationale-compliant sub-competition, to be held in August 2009. The organizers opened the event to jet aircraft, hoping to attract warbirds. Parsons contemplated entering his L-29: “I thought that I might have a *chance* of winning if I entered my jet. But on our second or third beer, I suggested to Gavin we enter one of his Boeings. Before I knew it, I heard myself say: ‘I’ll hire the Boeing for the day.’”

Branson immediately contacted his chief pilot, Captain Mark Nel. “I’ve never had a request like that before,” says Nel. “Usually it’s a call to do a charter flight into some African country, or to stand by for a posting to a far-flung Middle East contract. Flying a Boeing 737 around a 300-mile course for a flying club event stretched my sense of humor.”

Rustenburg’s runway was too short to accommodate a 737, so Nel and First Officer Hugo van den Berg helicoptered to the airfield to attend the obligatory pilots’ briefing, where they learned the 737 would be competing against a Hawker Hunter, an Aermacchi MB326, and an Aero L-29.

FAI rules usually require that record flights follow an out-and-back routing, but safety considerations dictated a

On race day, the 737 departed Lanseria Airport, traveling the 38 miles to Rustenburg in minutes, and lined up with the runway, where Nel and van den Berg swept through the start gate to begin the timed course.

Many on the ground assumed Nel and van den Berg would be hunched over the Boeing’s controls, closely monitoring the flight’s progress and squeezing every knot out of the jet to return to the finish line as quickly as possible. Not so.

“We leveled off at flight level 105, and engaged the autopilot,” Nel says. “Then we asked the cabin crew to bring us a cup of coffee, juice, and a sandwich. We let the autopilot and [flight management system] take us round the course whilst Menno called out landmarks he could see from the cockpit windows. With the turn points programmed into the system, the Boeing flew itself around Bloemhof Dam and Leeudoring and

settled nicely onto the return track whilst our cabin crew enjoyed the flight in the business-class cabin.”

Although the Hawker Hunter started the course later, it finished first, completing its run in 37 minutes, 38 seconds. The 737 came in second, crossing the line at 51 minutes, 14 seconds. The Aermacchi MB326 came in third.

After crossing the finish line at low level and completing a pass down the runway, Nel and the crew returned to Lanseria—wrapping up a not-so-routine day at the office.



Captain Mark Nel (left, with First Officer Hugo van den Berg) insisted the crew wear full uniform during the air race.

dog leg on the 737’s return lap to avoid air traffic. The change added three miles to the course, but would add only about one percent to the elapsed time—a small penalty for the safety benefit.

A 737’s best speed at 5,000 feet would be Mach 0.64, or 360 knots (415 mph). (The Hawker Hunter, on the other hand, has a maximum speed of 620 knots. Because of this advantage, the aircraft were split into different classes.)

■ ■ ■ JOHN MILLER

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